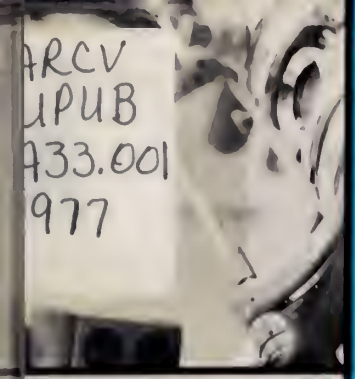
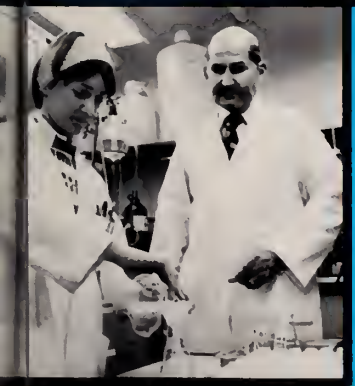


agricultural research

AN INVESTMENT IN MARYLAND'S FUTURE

ANNUAL REPORT-1977

AGRICULTURAL EXPERIMENT STATION-UNIVERSITY OF MARYLAND



With my first year in the director's job behind me, I can report to you that the Maryland Agricultural Experiment Station has a strong viable research program with both a national and international reputation for its good work.

This is not only my view, but the substance of the findings of a team of eminent U.S. agricultural scientists and administrators which, this past year, reviewed both the research effort and the management of the station.

The foundation and strength of the Experiment Station are its people, who are well trained, highly dedicated and productive. Maryland is indeed fortunate to have such an outstanding resource working to solve today's and tomorrow's agricultural problems.

At the same time, the review focuses attention on the problems and challenges facing the Maryland station if it is to continue to make significant contributions to the state's agriculture at an acceptable rate.

Chief among these problems is inflation. Its impact on the cost of doing research has more than offset small increases in support from both state and federal sources. Its worst effect has been on faculty salaries, which are no longer competitive with those of agricultural research institutions at the federal level and in other states. These same rising costs have also made it difficult to provide the operating support necessary for effective research in terms of equipment and facilities.

Our challenge is to look to the future. Agriculture and its problems have become increasingly more complex. Although some solutions will come quickly, the development of major new technology has become more difficult. Our scientists and engineers will have to work harder to achieve major breakthroughs; society must be prepared to support their efforts at a higher level than in the recent past. The results of our investment in a strong agricultural research program will be enjoyed by all Maryland citizens in terms of abundant nutritious foods at reasonable prices and good health and a sense of well-being. Above all, the results will help keep Maryland a strong agricultural state.

This issue of our Annual Report highlights some of our activities and accomplishments. I hope that the articles will help explain why agricultural research is so vital to all of us.

W. Lamar Harris
Director
Maryland Agricultural Experiment Station

Environmental Quality

James R. Miller

Assessment of Nonpoint Source Pollutant Loadings

The Federal Water Pollution Act (PL 92-500) requires each state to have a continuing planning process that includes: assessment of water quality, establishment of water quality objectives and development of a management program to make coordinated decisions affecting water quality.

Maryland Agricultural Experiment Station scientists and engineers at the Agronomy-Dairy Forage Research Farm have initiated research to assist in identification and assessment of water quality problems caused by specific categories of nonpoint sources of pollutant. The research focuses on practices which are common to Maryland agriculture, including no-tillage corn production, conventional corn tillage, alfalfa hay production and animal grazing.

The research will evaluate the sediment, nutrient and pesticide loadings from selected cultural practices for Maryland weather and soil conditions. Data from the research will provide a base to evaluate the effect of management practices on the reduction of nonpoint loadings. The data will be available to all persons involved in the water quality planning process.

Recreational Carrying Capacity of State Forests

Experiment Station scientists have developed a carrying capacity model for recreation levels in forested areas, and an atlas to aid forest managers in their planning use levels and types of use of forested areas. This information has been very helpful in developing state forests in Maryland for recreational uses.

Composted Sewage Sludge in Forest Nursery Seedling Production

Forest nursery seedlings are generally produced on sandy loam soils to facilitate digging and shipping plants bare root. Such soils are usually low in organic matter and must be irrigated frequently to maintain adequate soil moisture for normal plant growth. They must also be limed and fertilized more often because the nutrients are more readily leached from the root zone.

The utilization of composted sewage sludge for the production of forest nursery seedlings appears to be an environmentally safe means of using this once discarded organic waste. Because forest seedlings are not consumed as food and are grown in the treated soils for only 1 to 2 years, it is unlikely that the diseases or heavy metals often associated with sludges would be injurious.

Results indicate that high quality hardwood and softwood seedlings can be grown in soils amended with 50 to 100 dry tons of compost per acre without additional lime or fertilizer. Seedlings grown at these levels developed more fibrous roots than seedlings grown with higher levels of compost or with commercial fertilizers. Hardwood seedlings grown in the screened compost-treated soils were more resistant to winter injury than seedlings grown in adjacent beds fertilized with commercial fertilizer. Screened sludge compost can also be used as a fall mulch over year-old seedlings, eliminating the need for applying fertilizers.

Forest and Grass Buffer Strips Reduce Pollution

Land application has been the accepted practice of animal waste disposal throughout history. Recent environmental concerns relate to the magnitude of surface runoff pollution from manure-treated land. As a result, scientists evaluated the effectiveness of forest and grass buffer strips in reducing microbiological and chemical pollutant levels in surface runoff from manure-treated areas.

A 12.5 ft. Kentucky 31 tall fescue grass buffer strip reduced the fecal coliform levels of manure-polluted runoff by 98 percent during five rainstorms following manure application. The am-

Bottle samples of runoff from an experimental plot are being gathered by Dr. James Ayars to compare the effects of different cropping patterns on the microbiological and chemical pollutant levels.

monium and nitrate levels in the runoff water from the manure-treated area were reduced to the level of the control area 12.5 ft. from the application zone.

Forest buffer zones were also found to be very effective in improving the water quality of manure-polluted runoff. The results indicated that fecal coliforms, total dissolved nitrogen or total dissolved phosphorus in the manure did not exhibit significant movement beyond 12.5 ft.

Forest or grass buffer zones can effectively reduce pollution and help improve water quality of manure-polluted runoff.

Development of X-ray Spectrograph Techniques

High concentrations of heavy metals in the soil may be toxic to plants and animals. Since heavy metals may be present in sewage sludges, it is important to determine the fate of these metals when sewage sludges are applied to land. Accurate methods for measuring the heavy metals, zinc, copper and nickel in soils, sewage sludges, plants and animal tissues by x-ray spectroscopy have been developed by soil scientists of the Maryland Agricultural Experiment Station. The x-ray spectrograph methods are very rapid and will be useful for monitoring heavy metals in sewage sludges, soils and plants.

Soil Properties Influence Availability of Heavy Metals to Plants

Research conducted on a wide range of Maryland soils shows that soil pH is the most important soil property affecting the availability of heavy metals to plants. Much less of the metals is taken up at pH 6.5 than at pH 5.5. Also, the uptake of the heavy metal cadmium by plants is less affected by soil pH than the other heavy metals. Because of health implications, cadmium is of great concern in the food chain; it is very important that this heavy metal be kept at a minimum in soils and plants. This research demonstrates the importance of liming soils to pH 6.5 for good crop yields and reduction of the uptake of heavy metals by plants.

Dr. Francis Gouin holds a nursery seedling that has been grown in composted sewage sludge soil. Seedlings grown under these conditions have shown good root development and faster growth rates, in some cases, than seedlings grown under conventional practices.

Dr. Delbert Fanning points out how soil pH can influence the movement of heavy metals in the soil profile.

Another soil property that influences the uptake of the heavy metals by plants is the cation exchange capacity (a measure of the ability of the soil to hold positively-charged ions). As the cation exchange capacity of the soils increases, the heavy metal uptake by plants tends to decrease.

Soil Temperature and Crop Response to Sewage Sludge

Large amounts of sewage sludge are produced annually. Because these materials contain nitrogen, phosphorus and other plant nutrients, they are a potentially valuable source of plant nutrients. In addition, sewage sludges are high in organic matter which can be valuable as a soil conditioner.

Unfortunately, sludges sometimes contain relatively high amounts of heavy metals that can be phytotoxic and pose a threat to the human food chain.

The availability of heavy metals and plant nutrients is closely related to the organic fraction of sewage sludge applied to soil. Soil temperature is important in the degradation of organic matter, and use of sludge under conditions which stimulate degradation should be carefully evaluated. In addition to influencing plant growth and metal availability, soil temperature affects plant uptake and translocation of heavy metals.

Experiment Station researchers studied the relationships between field soil temperatures, sewage sludge application, plant growth and heavy metal uptake by plants. Significant research findings are:

1. Sewage sludge applications result in increased levels of zinc, cadmium, copper and nickel in both soil and plants.
2. Organic matter added via sewage sludge decomposes with time and this decomposition increases at higher soil temperatures.
3. Total uptake of heavy metals by plants increases in a straight line relationship from low to high temperatures.
4. Crops differ greatly in their ability to accumulate heavy metals. Vegetables are generally higher than forage legumes, which are higher than grain crops. Corn silage is higher in heavy metals than corn grain.
5. Soybeans are more adversely affected by the application of sewage sludge than corn.

Soil samples are placed in an x-ray spectrograph to determine the heavy metal content of sewage sludge applied to soils.

Weed Control in Vegetable Crops

The development of effective weed control for vegetable crops is essential for the production of high yields with good quality. The dependence on herbicides for weed control has increased due to the lack of hand-hoeing labor and to the increased costs of this type of labor. Some weeds can reduce the quality of the vegetable product through contamination; for example, the poisonous black nightshade berry cannot be separated from lima beans during processing of the beans. Therefore, lima bean fields with black nightshade weeds must be abandoned or hand labor must be used to pull the plants.

Previously, the registered herbicides were not very effective in controlling black nightshade. The herbicide alachlor, applied at planting, is very effective for nightshade control in lima beans, and a state label for Maryland was granted this year. Additional studies show that dinoseb can be applied broadcast postemergence over lima beans to control black nightshade which has already become established. This will provide a second control technique if the preemergence herbicide control is inadequate.

Wind erosion on the Eastern Shore reduces the environmental quality. These terrific sand storms cause thousands of dollars damage to young vegetable crops in the spring and may even prevent some cultural techniques such as seeded tomatoes. No-tillage studies have shown that most vegetables can be planted in an overwintered rye cover crop stubble which prevents wind erosion. Acceptable yields have been obtained with sweet corn, seeded tomatoes, snap beans, lima beans and watermelons. In these studies, seeded tomatoes have been killed by sand-blasting in conventionally plowed and tilled areas. In no-tillage areas, the tomato seedlings were completely protected.

Weed Control in Conventional and No-Tillage Corn

Some preemergence herbicides which give consistently satisfactory annual weed control in conventional planted corn may fail in no-tillage corn. With no-tillage corn in Maryland, the best annual

Dr. Morris Decker examines the rooting system of pasture grass that has been sprayed with sewage sludge. This sample will be used to compare the heavy metal and plant nutrient contents with those of pasture grass fertilized conventionally.

weed control results from the triazine herbicides. Two acetanilides, alachlor and metolachlor alone or in combination with triazines, may or may not effect satisfactory annual weed control. In a comprehensive Experiment Station study, done under laboratory and greenhouse conditions, three methods of dissipations (leaching, volatility and photodecomposition) were investigated to determine if any one of these was the cause of the inconsistent performance of the two acetanilides.

Most no-tillage corn is planted in a vegetative cover, whereas conventional tillage is planted in tilled soil free of surface plant debris. Leaching with 1-cm (0.38 in.) increments of water (10-cm [3.8 in.] total) from orchardgrass, wheat straw and dried corn stalks revealed that significantly more acetanilides and atrazine leached than simazine. This indicates that acetanilides are not bound to plant debris. After 8 days, herbicide loss via volatility from glass, grass, straw and soil surfaces was less than 2 percent for atrazine and 0.5 percent for simazine.

Vapor losses after 8 days for alachlor and metolachlor, respectively, were: straw — 9.3 and 17 percent; tall fescue — 10 and 11.5 percent; giant foxtail — 19.1 and 36.6 percent; glass — 52 and 52.5 percent; and soil — 0.1 and 0.1 percent. When alachlor was applied to giant foxtail leaves and exposed to sunlight for 7 days, 1.5 percent was photodecomposed. Under the same conditions, 1.1 percent of metolachlor photodecomposed. The greater volatility of the acetanilides and the greater photodecomposition of alachlor are two factors responsible for erratic annual weed control in no-tillage corn.

Nitrogen Fertilizers for Small Grain Production

Granular urea is expected to become a major source of nitrogen fertilizer in the future because of its favorable cost and improved storage quality. Since this nitrogen fertilizer will be available for use in Maryland, research is being conducted to determine the response of crops to granular urea compared to prilled urea and ammonium nitrate.

The results show that the different sources of nitrogen when drilled with wheat in the fall gave similar yields with up to 30 lbs. per acre of nitrogen. However, when 60 or 120 lbs. per acre of nitrogen from prilled or granular urea was drilled with the seed in the fall, the yield of wheat was reduced. When nitrogen was topdressed on established stands of wheat in the spring, the prilled form of urea and ammonium nitrate performed equally well, and the new granular form of urea appeared to be slightly inferior.

Effects of Cropping Systems on Yields of Corn

Cropping systems are largely responsible for differences in soil organic matter content and soil aggregate stability. Soil aggregate stability plays an important role in water infiltration and soil erosion. High aggregate stability contributes to reduced soil erosion and stream pollution from cultivated fields. The soil aggregates are not easily carried by the moving water and there is less water running off the fields because of better infiltration. Experiment Station research has been designed to check the length of time that high aggregate stability, created by good cropping systems from the standpoint of aggregate stability, will persist in the soil under the continuous corn cropping system. Continuous corn under conventional tillage practices causes low soil aggregate stability, but is one of the most widely used cropping systems in Maryland. The results of this experiment show that high aggregate stability created by crops such as continuous bluegrass or continuous orchardgrass persist for a long time under continuous corn.

After the fifth year of continuous corn, the corn which followed bluegrass yielded 141 bushels per acre. The corn on low aggregate-stability plots, which had been in bare fallow for 20 years previous to the start of continuous cropping with corn, produced only 84 bushels per acre. Aggregate stability and soil organic matter were greatly reduced by the continuous corn in the plots that had previously been in bluegrass, but there was still enough difference to affect the yield.

Dr. Edward Strickling and C. J. Flessner take a water sample from an experimental plot that has been planted in corn for several years to test the effects of continuous cropping systems on water infiltration and soil erosion.

Pest Management Research

Allen L. Steinhauer

In recent years the pest problems confronting producers of agricultural crops have become increasingly complicated as a result of higher energy costs, environmental restrictions and the breakdown in some areas of pest control technology. As a result, a more unified approach to pest control has become necessary, and integrated pest management has emerged as an interdisciplinary research approach to the suppression of insect, nematode, weed and disease problems. The Maryland Agricultural Experiment Station conducts a multi-pronged research effort involving plant breeding for resistance to pests, chemical control of pests, biological control of pests and the effect of ecological and cultural manipulations on pest abundance. These studies encompass research on most pest problems on the majority of agricultural crops in Maryland.

Plant Breeding

In 1974 plant breeders at the University of Maryland released the soybean variety Shore with resistance to Mexican bean beetle feeding. Currently, an experimental breeding line is being evaluated as a potential new cultivar, and a decision on its release will be made in early 1978. This line has consistently yielded more and exhibited greater disease resistance than Kent, the cultivar it would replace.

The Maryland tobacco breeding program has produced three released cultivars with resistance to tobacco mosaic, two with black shank resistance and one resistant to wildfire. All of these have some resistance to black root rot and Fusarium wilt. Several breeding lines with multiple disease resistance are currently being evaluated for quality of cured leaf, chemical content, smoke taste and aroma. These have the potential for release as new cultivars within the next 2 or 3 years.

Approximately 100 early lines with multiple disease resistance are under evaluation for yield and quality, with potential for further release of improved cultivars. Studies are also under way to develop cultivars resistant to severe etch virus. These studies are in an earlier stage, but four crosses with high disease resistance show good tobacco characteristics. Breeding for pest resistance is most effective for disease control, and generally less so for insects. However, even a modest level of pest resistance may simplify pest control in combination with another pest management practice such as chemical, cultural or biological control.

Joseph Wiltbank and Dr. William Kenworthy examine a plot of an experimental soybean variety that is being tested for resistance to Mexican bean beetle damage.

Chemical Pest Suppression

Research with pesticide chemicals continues to provide immediate answers to costly pest problems in agriculture. Greater environmental restrictions, increased cost of pesticides, development of resistance by pest species to pesticides and the constant threat of cancellation of effective pesticides have intensified efforts to find substitute pesticide and nonpesticide alternatives.

The recent cancellation of dibromochloropropane (DBCP) for control of nematodes in strawberry nurseries in the Salisbury area is an example of the urgency of research needs. Experiments with a number of substitute possibilities have shown that either Temik or Nemacur provide excellent control of nematodes without any adverse effect on plants.

Reduced tillage in vegetable crop production depends largely on the control of weeds. Perennial weeds in asparagus reduce yield; research during 1977 showed the herbicide Roundup® to be effective in asparagus weed control. Canada thistle, tall thistle, dock and milkweed are presently without practical controls.

Dr. James Parochetti checks the rooting and rhizomes of a plant of johnsongrass. Reduced tillage in crop production depends on the development of effective weed control.

Most weed control programs are based on the use of preemergence treatments. It is possible that treatments may be applied unnecessarily, so the development of postemergence herbicides that are used only when needed is a good pest management practice. Two experimental products (HOE-23408 and HOE-29152) have shown good selectivity both as pre- and postemergence sprays on tomatoes, snap beans, lima beans, cucumbers and watermelons.

Certain agronomic practices such as minimum tillage cropping provide environmental benefits. Reduced runoff and silting plus moisture conservation are desirable from the standpoint of reducing stream pollution and increasing production. The use of herbicides is essential to this practice.

Research on selective weed control chemicals in no-tillage corn and soybeans was conducted by Experiment Station researchers at four Maryland locations in 1977. In no-tillage field corn, the normal practice of applying preemergence herbicides did not provide season-long fall panicum control. Experiments with herbicides applied after fall panicum sprouted and emerged showed that the foliar herbicides paraquat and glyphosate killed fall panicum. Of the preemergence herbicides, pendimethalin (Prowl) at 1.5 lbs. per acre resulted in 10-15 percent stand loss.

Use of protectants in conjunction with herbicides could greatly reduce the incidence of herbicide damage to crops. In conventional tilled corn, a plant protectant (Stauffer R-29148) was effective in preventing injury to corn by the herbicides EPTC (Eptam), butylate (Sutan) and vernolate (Vernam), up to 16 lbs. per acre for each herbicide. Additional research with bentazon (Basagran) pinpointed the importance of timing of application in control of broadleaf weeds in corn such as jimsonweed, smartweed, lambsquarter and annual morning-glory. Many of these weeds are susceptible only in early growth stages.

The desirable increase in no-tillage corn practices has been accompanied by the appearance of additional pest problems. Many insects that are usually not important in conventional field corn are now damaging pests. Cutworms, armyworms and stalk borers can heavily damage no-tillage corn. The threat of cancellation of toxaphene, the most practical and effective control of these pests, has accentuated the need for discovering alternative control methods. The Maryland Agricultural Experiment Station is developing an integrated pest management research program to determine feasible alternatives and unify the various pest control strategies. Determination of threshold

Minimum tillage cropping of soybeans and corn reduces runoff and silting, two causes of stream pollution.

levels of pest infestation (insects per plant, weeds per foot-row, etc.) is necessary in order to apply pesticides only when pests inflict losses greater than the cost of action. Thresholds of action have been developed for defoliating insects in soybeans, lima beans, snap beans, mites on soybeans, ear feeders on sweet corn and alfalfa weevil on alfalfa.

Research has also illustrated some pesticide usages that appear counterproductive, such as the application of systemic insecticides on soybeans and subsequent infestations with spider mites. There appears to be a physiological change in plants that allows the mites to increase rapidly when conditions favor mites. This same mite increase does not occur in untreated soybeans.

Research is also being conducted to improve monitoring schemes for pests. This involves the use of light traps to determine the presence of pest insects before they lay eggs; the utilization of weather data to predict insect activity, disease prevalence or weed germination; and the monitoring of beneficial insects to consider their potential effects before making pesticide applications. These factors are integrated to provide pest management for any crop system.

Based on work in Pennsylvania, the practice in apple orchards has been developed of monitoring a ladybird beetle and a predatory mite that are capable of controlling the European red mite. Only pesticides with little or no effect on these predators are used in spray programs. This eliminates the use of special sprays for mite control.

Another problem now being considered by the Maryland Agricultural Experiment Station is the registration or re-registration of effective chemical controls. Because of insecticide residues and other problems of environmental safety, the Environmental Protection Agency (EPA) is requiring more research data each year for the registration of new compounds. In some instances a few of the most effective insecticides have had their registrations cancelled. Of greater significance is the fact that even more of these compounds are expected to have their registrations limited or cancelled. These restrictions, coupled with the problems of insecticide resistance, make it increasingly important to screen alternative pesticides to fill the gap.

Presently, insecticide screening trials are being conducted on approximately 10 different vegetable crops on over 600 plots. As a result of these trials such new compounds as Orthene, Plictran, Lorsban, Penncap-M and Pirimore have received use registrations on certain vegetable crops. Many of the established insecticides have had their labels expanded to cover additional vegetable crops or additional insect pests. One such case is the emergency use registration for azinphos-methyl (Guthion) to control carrot weevil. This

registration was granted by EPA to the commercial carrot growers of Maryland for the 1977 growing season.

Future research will emphasize the timing of sprays and insect thresholds. For example, preliminary studies have established the timing of sprays for the control of tomato fruitworm. Spray criteria for this same pest (corn earworm) have already been successfully developed for sweet corn.

Related to pesticide research, but more basic, is an Experiment Station study of the chemical tricyclazole for fungus disease control. This chemical does not directly affect the disease organism, but apparently stimulates the plant on which it is applied to resist fungus disease development. Tricyclazole prevents infection of rice plants by the fungus *Pyricularia oryzae*. The mechanism of this unusual reaction is being studied to develop compounds more effective and less hazardous than those materials currently in use.

Biological Control of Pests

As alternatives to insecticides, there is great potential in the use of natural enemies of pest insects. These biological control agents, such as parasites, predators and diseases, can be used exclusively if they are effective enough, or in combination with other pest suppression methods such as host plant resistance, pesticides or cultural practices.

One of the better examples of biological control is the use of an imported parasitic wasp in the control of the Mexican bean beetle on soybeans. Refinement in the practice is being researched; also, the search for additional natural enemies of the Mexican bean beetle and the corn rootworm complex has been initiated. Studies of parasites of the alfalfa weevil show the necessity for the release of additional parasites in western Maryland. The possible manipulation of Nantucket pine tip moth parasites to lessen damage to loblolly plantations is also being studied.

Experiment Station researchers are presently studying virus diseases that attack insects. The fall armyworm is a pest on many crops, and researchers are attempting to increase the virulence of an armyworm disease to make it a practical control method. In conjunction with these increased virulence studies are constant checks on the effect of the virus on mammalian tissue cell lines. There is no evidence to suggest infectivity in mammalian tissues, even though virulence to the insect host has been increased. Studies such as this indicate the alertness of the Experiment Station to environmental and health problems possibly associated with pest control practices.

Biological control research is usually much slower in producing results than more conventional technology, but like plant breeding, successes are extremely cost beneficial and usually long lasting. Unlike the work with pesticides, work on biological control, plant breeding and other pest management practices is directed toward long-term solutions.

Scientists such as Dr. Charles Reichelderfer are attemptiog to increase the virulence of certain beneficial viruses to make this method of pest control practical.

Ecological Approaches

In the overall program of pest management there are many unknowns. Most agricultural systems have not been thoroughly explored for the interrelationships between the various components, such as the crop plants, insects, weeds and microorganisms. Frequently what we do to eliminate one pest, or increase yield, or conserve water, or some other practice has an effect on some other component. Although these effects are usually not serious, occasionally they are.

We have already cited how minimum tillage augments insect problems and the use of systemic insecticides increases mite problems on soybeans. Prior knowledge of ecosystem relationships would aid greatly in predicting the effects of various practices. The Maryland Agricultural Experiment Station has instituted research on turf grass system structure to clarify this type of relationship. A comparative study between artificial grass systems (turf) and native grass systems (marsh) could aid in understanding changes brought about by cultural practices.

Cultural Practices

Viruses reduce the yield and quality of many crops, especially those that are vegetatively propagated. The most effective means of controlling virus diseases in such crops is through the use of virus-free propagating stock. At present virus-free propagating stock is obtained from plants that have been indexed and certified virus-free for specific viruses. Certain states and countries are mandating international quarantines for virus-free nursery stock. The Maryland State Department of Agriculture, through a cooperative agreement with the University of Maryland, has initiated a certification program for virus-free plants of *Fragaria* spp., *Rubus* spp., *Malus* spp., *Prunus* spp., *Pyrus* spp. and *Vitis* spp.

Aflatoxins

The rise in aflatoxin in 1977 merits mention of this "pest" and current efforts to suppress it. A survey for the presence of aflatoxins in Maryland field corn was conducted, and 300 samples from throughout the state were analyzed for aflatoxins. In addition, the susceptibility of corn varieties to aflatoxins and the influence of fertility practices on aflatoxin levels are being studied to determine if altering the amount or type of fertilizer could be a means of reducing aflatoxin levels in the field. Also under investigation is the potential problem of aflatoxin occurrence in corn stored under high moisture conditions.

Laboratory studies are concerned with aflatoxin control other than by the use of pesticides. Studies on the use of antagonistic organisms, treatment of plant products with the solvent dimethyl sulfoxide and chemical comparisons of peanuts, soybean and corn substrates and their influence on aflatoxin production are currently under way. Hopefully these field and laboratory studies will lead to a more efficient, less expensive means of either reducing or eliminating aflatoxin problems on susceptible crops such as corn and soybeans.

Dr. George Bean examines a sample of corn gathered throughout the state for possible aflatoxin damage. Researchers are trying to determine ways to bring this pest under control.

New Crop Development

Timothy J Ng

The geographic diversity of Maryland is reflected in the vast variety of crops that are commercially produced. From the vegetable and melon industry of the Eastern Shore to the lucrative tobacco industry in the coastal plain area of Southern Maryland, agricultural crops play an extremely important role in the economy and well-being of the population of the state.

Regardless of the commodity raised, there is a continuing need for new varieties to improve yield and quality during production and to adapt to changing environments and production practices. The hot humid climate is particularly conducive to diseases and insects, and indigent pests can severely limit production. In addition, the presence of new pests requires the development of new resistant varieties. Encroachment of metropolitan areas into rural locations is eliminating acreage once used for production and increasing pollution, but it is also creating an expansion of plant production in the urban agriculture area. Changing demands from processing to fresh market production require new plant types.

Even in production practices, emphases are changing. In the vegetable and fruit industry, establishment of lucrative roadside markets and pick-your-own operations have created a demand for varieties with good flavor and appearance that do not necessarily have to withstand long shipping distances. In field crops and vegetables, the increasing use of mechanization for planting, cultivation and harvest; no-tillage systems of production; and double-cropping also create a demand for new varieties adaptable to these practices.

Within the Maryland Agricultural Experiment Station, research is conducted in breeding and identifying new varieties of crop plants to meet these changing environmental conditions and production practices. Genetic adaptation of new varieties is important, especially when compared with the more expensive alternatives such as fungicides, insecticides and growth regulators, and with pollution concerns. In breeding new varieties for the unique climatic and edaphic conditions of Maryland, a team approach has evolved in the Experiment Station involving close cooperation between agronomists, engineers, economists, horticulturists, physiologists, geneticists, soil scientists and pathologists. Their goal is to continually search for, select and identify new varieties of different crops to keep Maryland's agricultural industry viable and vigorous.

Dr. James Miller, Dr. William Kenworthy and Louis Smith discuss a new soybean variety bred to produce high yields, high protein content and resistance to insect pests.

Field Crops

The production of oilseed, grain, forage and tobacco crops occupies a large percentage of the acreage under cultivation in Maryland. Breeding for crop improvement within the Experiment Station and evaluation of varieties obtained from other state, federal and private breeding programs have resulted in the release and identification of many varieties suitable for production in Maryland.

Soybean, a crop that has come into prominence in the past 30 years, is a versatile commodity: it is adaptable as a food extender because of its ability to blend with other foods, it produces an edible oil, it is useful as a green manure, and a high protein content makes it a valuable component in feedstuff for livestock and poultry. Scientists at the Experiment Station and in cooperation with U.S. Department of Agriculture (USDA) personnel are actively involved in breeding new varieties of soybeans with high yields, high protein content, resistance to insect pests such as Mexican bean beetle, earworm and soybean looper, ability to grow rapidly in response to high fertility levels of potassium and phosphorus, and adaptability to double-cropping systems. Six varieties have been released within the past 10 years. The most recent of these, Shore in 1974, is a high-yielding variety with good quality and resistance to the Mexican bean beetle. In addition, two breeding lines are currently in the advanced stage of testing and are under consideration for varietal release.

Active breeding work is also under way in small grains; three wheat varieties have been released from this program. Potomac, released in 1975, is a variety with excellent test weight, good resistance to powdery mildew and leaf rust diseases and improved yield. Breeding is continuing with emphasis on improved disease resistance and straw strength. In barley, research is being conducted to increase and enhance the xanthophyll content of this grain to make it more acceptable to the poultry industry. If this project is success-

ful, barley could substitute for corn as a feed source to provide the yellow pigment necessary for broiler production.

Forage crops in Maryland are plagued by the alfalfa weevil, anthracnose, leaf spot diseases and root and crown rots. Research is being conducted in close cooperation with the USDA to identify adapted alfalfa varieties with multiple pest resistance. Two recent releases from this program, Team and Arc, are high-yielding varieties with resistance to the weevil, leaf spot and anthracnose. Arc contains a higher resistance to anthracnose than Team and is also resistant to bacterial wilt. Different varieties are being evaluated in search of higher protein content; high protein in alfalfa is associated with high dry matter digestibility when it is used as a feed.

Experiment Station tobacco breeding has had an extremely successful history. Over 92 percent of the acreage devoted to tobacco in Maryland is planted with six varieties that have been released by this program in the past 12 years. Most of these varieties are tolerant to weather fleck. Some also carry resistances to black shank, wildfire and tobacco mosaic virus, as well as yielding high quality leaves with excellent filling capacity. In cooperation with the USDA, new varieties are being developed with genetic resistance to air pollution. The feasibility of hybrid production of tobacco is also being investigated.

In addition to these breeding programs, extensive testing of new varieties of hybrid corn is being conducted in 14 locations around the state. These new varieties are evaluated for yield, disease resistance, standability and maturity to identify superior varieties adapted to Maryland.

Vegetables and Fruits

Although vegetable production acreage is spread across the state, it is more concentrated on the Eastern Shore because of the favorable soil and climate. New varieties of broccoli, cabbage, cauliflower, cucumbers, eggplant, muskmelon, snap beans, squash, sweet corn, sweet potato and watermelon are grown at the Vegetable Research Farm in Salisbury and tested for their production performance. Within the Experiment Station, active breeding programs are being conducted with tomatoes, sweet potatoes, melons and snap beans.

The tomato program in Maryland is involved with the breeding and selection of tomato varieties that exhibit a concentrated fruit set, firmness, high yield and resistance to diseases and fruit cracking as well as desirable processing and fresh market qualities. Recent releases have included the processing varieties Dorchester and Caroline, the home garden cherry tomato Summer Salad and the fresh market variety Westover. Westover, released in 1975, is an early-midseason variety with concentrated set and ripening, good color, excellent flavor and resistance to cracking and to Fusarium and Verticillium diseases. It produces attractive, globe-shaped fruits and has been widely accepted by both growers and consumers during the 2 years since its release.

Sweet potato breeding has concentrated on selecting roots with high vitamin content, good yield, uniform size and shape, good storage and processing qualities and disease resistance. Two varieties released by the Maryland Agricultural Experiment Station, Redmar in 1971 and its yellow-skinned mutant Goldmar in 1972, produce heavy crops of very uniformly-shaped sweet potatoes. Moist fleshed with excellent baking qualities, these varieties are also considered adaptable for processing by Maryland canners.

Joseph Wiltbank shows Dr. Allan Bandel the ear development of a new bybrid corn variety being evaluated for yield, disease resistance, standability and maturity.

Dr. Cbarles Reynolds takes a second cutting of broccoli from an experimental plot at the Vegetable Researcb Farm in Salisbury. Varieties of tomatoes, sweet potatoes, melons and snap beans are tested at this location for performance potential.

Muskmelons are being bred to produce varieties with attractive external appearances, good netting, excellent flavor and sugar content and high resistance to Fusarium wilt. Work is also under way to develop bush varieties of muskmelons to increase yields per acre, and to increase suitability of the melons for mechanical harvesting. Snap beans are being evaluated to identify sources of genes which will allow bean plants to set and grow pods under high temperature conditions. An extensive collection of bean varieties from domestic and foreign sources has been accumulated for this purpose.

Apples, peaches and strawberries are the major fruit crops of Maryland; pears, cherries, nectarines, plums, black raspberries and wine grapes are produced in limited quantities. Breeding work with peaches has resulted in the release of the Mar series of peach varieties: Marglow, Marhigh, Marland, Marqueen, Marsun and Marpride. In addition, new apple and peach varieties are constantly evaluated for their potential as scions and rootstocks under Maryland conditions.

In cooperation with the USDA, a strong and diversified strawberry program has been established to breed new varieties with resistance to red stele root rot. Since 1968, this program has resulted in the release of three new varieties for production in Maryland. These are the midseason variety Redchief (1968) and the early varieties Darrow (1974) and Earliglow (1975). All three varieties are resistant to five races of red stele and carry moderate resistance to Verticillium wilt and leaf scorch. Their high quality in terms of flavor, color and appearance make them ideally suited for pick-your-own operations as well as for frozen produce. In addition, four advanced June-bearing and two everbearing strawberry selections look promising as potential releases.

Scientists at the Maryland Agricultural Experiment Station have developed three new strawberry varieties resistant to red stele root rot and superior in flavor and appearance.

Urban Agriculture

With the growth of metropolitan areas, urban agriculture is increasingly important in Maryland today. The demand for aesthetics in landscaped areas and recreational playgrounds, and the increased popularity of house plants and home gardens have created a large supportive industry in landscape design and maintenance, and in floral and ornamental plant production.

In cooperation with seven other Northeastern states and the USDA, the Maryland Agricultural Experiment Station is involved in the development of turfgrass varieties adapted to the environmental conditions of the Northeast. Initiated in 1968, this program was originally designed to breed for superior Kentucky bluegrass varieties suitable for turfgrass in golf courses, athletic fields, airports, home lawns and other urban areas, but has since been expanded to include varietal development of fescue and ryegrass. Desirable qualities include durability, persistence, color and tolerance to such stress factors as heat, drought, diseases and insects. Researchers hope that blends combining the strengths and weaknesses of individual varieties will yield a turfgrass of higher quality than any individual variety in the blend.

In the field of home horticulture and greenhouse production of house plants, Experiment Station researchers are working to produce improved varieties of poinsettias, Kalanchoes and azaleas. Working with an ornamental that has long been a staple of the Christmas holiday season, they are attempting to develop more attractive poinsettia varieties that retain their leaves and bracts longer under the low light levels generally present inside the home. Kalanchoes are smaller succulents that are rapidly gaining in popularity as potted plants because of their long-lasting qualities and ease of propagation. They are being crossed and evaluated for their ability to produce a wider range of flower colors and more compact, widely-branched plant types. Fifty selections from the azalea breeding program are now being tested for winter hardiness, early flowering, flower longevity, vigor, branching, general attractiveness and forcing ability under greenhouse conditions.

Dr. Charles Darrah examines a plug of turfgrass grown at one of the Agricultural Experiment Station's research farms for desirable qualities such as durability, persistence and color.

Dr. James Shanks monitors the growth of poinsettias cultivated under the same low light conditions generally found in the home.

New Crops, New Horizons

The responsibilities and activities of the many Experiment Station breeding projects extend to the evaluation of new plants for potential crop production. Limanthes, more commonly known as meadowfoam, is being investigated because oil found in its seeds possesses the same high lubricating properties as the oil of the now-endangered sperm whale. The ash gourd, a cucurbit commonly grown in the Southeast Asian countries, is being studied for its long storage life without special storage conditions and its high resistance to the common cucurbit diseases. Eight species of conifers are being looked at for their growth and production potential as a Christmas tree crop, and 60 varieties of the Oriental persimmon are being evaluated for use as landscape plants for home grounds.

Basic genetic studies are also being conducted to develop advanced techniques in gene manipulation suitable for breeding programs. A system of rapidly reducing the chromosome number in peppers genetically and then increasing it chemically shows promise as a rapid means of developing inbred varieties. Tissue culture techniques and gene manipulations using these techniques may be a means of manipulating chromosome numbers in other species of plants and may also allow researchers to fix nitrogen from the atmosphere into plants via the insertion of nitrogen-fixing genes or organelles into their cells. Investigations into the physiological nature of diseases caused by fungi, bacteria and viruses and the mechanisms of resistance to these diseases in plants may increase the efficiency of incorporating these resistances into existing varieties and breeding lines.

The success of the crop improvement program at the Maryland Agricultural Experiment Station is a direct result of the close cooperation of scientists from many different disciplines within the Experiment Station, with researchers located at other state Agricultural Experiment Stations, the USDA and industry, and with private growers throughout the state. Working together, they have provided Maryland with adapted varieties of many crops to assure the steady production of high quality plant products. With the challenge of a changing environment, the continuing effort of the Maryland Agricultural Experiment Station to develop high yielding, high quality crop varieties is of considerable benefit to producer and consumer alike.

Nutrition of Animals and Nutritive Value of Animal Food Products

Richard F. Davis, Emory C. Leffel,
John H. Vandersall

Improving the efficiency with which human foods are produced by animals is a major objective of nutrition research by the Maryland Agricultural Experiment Station. Maximum use of grain by-products by all animals and use of forages, high fiber by-products and nonprotein nitrogen by dairy cattle, beef cattle and sheep, compatible with economical production, are important goals. Evaluation of animal food products and their contribution to human nutrition is a part of the research activity.

Animal food products are major sources of protein of a quality not easily available from vegetable or grain products. Milk and dairy products are major sources of calcium in the American diet. A number of vitamins and other minerals essential for optimum nutrition are supplied by these animal food products.

Improving Preservation of Animal Feeds

Nutrient losses from feed crops due to over maturity, weather and storage damage frequently contribute to significantly less animal production than the potential.

Losses in ground ear corn stored at 63-75 percent dry matter in airtight structures were reduced from 49 percent to less than 2 percent by the addition of acetic or propionic acid at 1.5 or 2.5 percent by weight. Temperature rise and mold growth were both reduced in the treated corn. Corn to which 1.5 percent acid was added was readily eaten by sheep; corn with 2.5 percent added acids was not eaten well. The digestibility of protein and dry matter were significantly higher for treated corn than for control corn.

Similar studies with 1.5 percent propionic acid added to ground alfalfa stored at 59-79 percent dry matter reduced storage losses from up to 32 percent to below 2 percent with concurrent improvement in the digestibility of nutrients. Dry matter intake, nitrogen balance and weight gain are improved for lambs fed the acid-preserved alfalfa.

Improving the Usefulness of Waste Products for Animal Feeds

Much of the energy stored in grain crops is in the stalks, frequently left in the field to decay. Experiment Station research with growing dairy animals has shown that corn stover (stalks and leaves) used to dilute high quality forages such as alfalfa hay can maintain animals or support satisfactory growth.

The rate of gain can be controlled by the amount of concentrates fed to the animals. When the forage was one-half stover and one-half alfalfa hay or hay-crop silage, the gain was 1 lb. per head per day when 3 lbs. of concentrate was fed. Increasing concentrate feeding to 4 lbs. per head per day supported a daily gain of 1.4 lbs. Feeding concentrates as 40 percent of a total ration resulted in a rate of consumption involving 8 lbs. of concentrate per head per day and a daily gain of 2.2 lbs. The same rate of gain was obtained when the stover was two-thirds of the mixed forage.

Using waste materials to lower the water content of forage crop silage is another approach to utilization by growing dairy animals. In one trial, 240 lbs. of corn stover was added per ton of green alfalfa before storage. Animals fed this silage required only 45 percent as much alfalfa as those fed wilted alfalfa silage for similar performance. When fed 4 lbs. of concentrate a day, the gain was 1.4 lbs. per day; animals fed wilted alfalfa silage had an average daily gain of 2 lbs. With this use of stover, less land would be needed for forage crops, increasing the land available for cereal grains or for feeding more cattle.

In another trial, 300 lbs. of chopped newsprint was added per ton of green material. While the resulting silage appeared desirable, the animals did not eat enough to maintain body weight. Results with laboratory silos indicate that other waste papers, such as paper bags, should result in a higher quality silage that will be satisfactory for growing animals.

John Kane prepares a sample of cecal contents to determine the importance of fiber in swine performance.

Wheat straw was chopped and treated with solutions of 3.3, 4.5 or 6.0 percent sodium hydroxide (NaOH) and included in sheep rations. Compared to untreated straw, treated straw supported a significantly better rate and efficiency of gain with improved digestibility of dry matter. Larger lambs exhibited a greater capacity to utilize the straw-containing diets than did smaller, younger ones. Treating wheat straw for feeding with NaOH is economical when alternative feeds are high in price or unavailable.

Fiber for Swine. The ability of nonruminant animals to use the fibrous carbohydrate fraction of feedstuffs is not clearly established. Experiment Station research during the last year shows that growing pigs can maintain adequate growth on standard corn-soybean meal diets with added fiber for a total of 25 percent calculated crude fiber. The effect of long-term (120-150 days) feeding of these diets on cecal size appears to be minimal. Analysis of samples of cecal contents is under way and will reveal whether long-term exposure to diets having 25 percent fiber affects the amounts or ratios of volatile fatty acids. Similar data will reveal the effect of monensic acid on cecal fermentation in pigs fed either standard or 25 percent fiber diets. Preliminary data suggest a propionic acid to acetic acid ratio similar to that observed in rumen fermentation.

Protein from Broiler Litter. Rations of feed grains and corn silage are deficient in protein and minerals for growing beef and sheep. Litter from broiler production, which is high in crude protein, might be used as a supplement in many cases replacing vegetable proteins or urea. Over 370,000 tons of broiler litter is available from the poultry industry on the Delmarva Peninsula. The nutrient content of broiler litter is affected by the storage treatment and the number of flocks grown on the litter. "Five flock" broiler litter contains 25 percent crude protein, 1.8 percent calcium and 1.4 percent phosphorus.

Broiler litter stored in piles goes through a heat and usually acquires a sweet carmelized smell. Temperatures reach 130-150°F in experimental piles; other piles have been observed to heat to charring. Broiler litter can be stored satisfactorily by insiling at 35-40 percent moisture content.

Similar gains were achieved when growing beef calves were fed corn silage supplemented with soybean oil meal or broiler litter (1.5 lbs. per head per day). Diets containing 49 percent broiler litter produced good results in maintenance rations but were too low in energy for growing cattle. Broiler litter appears to be worth 50-60 percent as much as soybean meal as a protein supplement for growing beef animals in rations with adequate energy.

Dr. John Vandersall checks one of the cattle being used to test the desirability of feeding forages that have been treated with chemical preservatives. The preservatives allow farmers to harvest forage crops at a bigher moisture content without fear of spoilage.

Dr. Richard Davis watches as Kay Templin filters a solution used to determine the optimum "solubility" for protein in dairy cattle rations.

Protein "Solubility" Studies

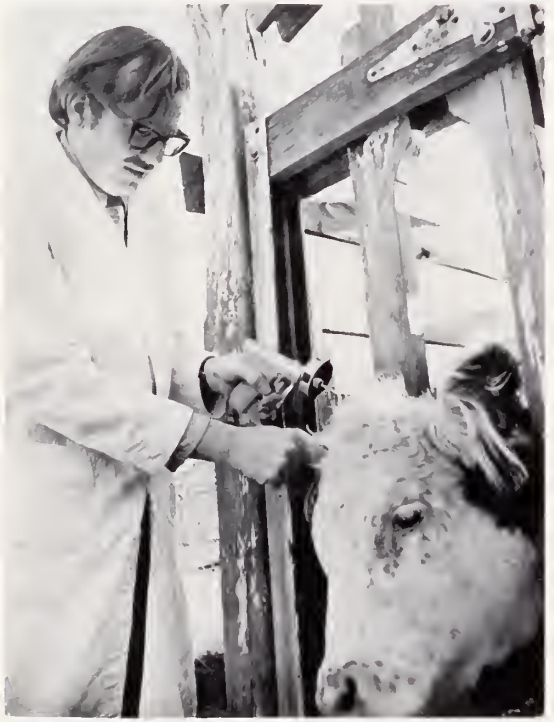
Recent reports indicate that the relative availability of protein for bacteria in the rumen of dairy cattle versus protein passing through the rumen for digestion in the lower tract may have important effects on the amount and efficiency of milk production. A study covering 28 weeks with 70 lactating cows established that the "solubility" of protein in the ration changes these production functions. There appears to be an optimum "solubility" for protein in dairy cattle rations. Milk production is depressed more by rations with protein "solubility" below the optimum level than by rations with higher than optimum solubility.

In the same study, cows fed rations with high levels of urea ate slightly less feed and produced slightly less milk. The "soluble" protein equivalent consumed from urea was not appreciably

different in usefulness from the "soluble" protein from natural sources.

Chemicals for Increased Growth Rate

Increased efficiency of beef cattle and growing dairy cattle can be achieved by increasing the rate of growth or rate of feed intake, or by altering the digestive processes for more effective utilization of feed nutrients. Studies with 41 Hereford and Angus steers on bluegrass and accumulated fescue pastures were conducted after weaning from October through December (84 days). The studies compared implanted Ralgro and Monensin offered in a commercially available salt block.



Growth stimulating chemicals are implanted in cattle by Dr. William Kunkle as part of an experiment designed to test the effectiveness of several chemicals in increasing the efficiency of beef cattle and growing dairy cattle.

Steers fed Monensin gained similarly to controls (1.55 lbs. per day) during the first 56 days but exceeded controls by .29 lb. versus .25 lb. per head per day during the last 20 days. Controls consumed .38 lb. per head per day of salt block while test animals ate only .13 lb. per head per day of the block with 400 mg of Monensin per pound. Steers implanted with Ralgro gained 17 percent faster than controls (1.10 lbs. versus .95 lb. per day).

The increased growth rate of cattle implanted with anabolic agents such as DES, Ralgro, Synovex S and Synovex H is well documented. These anabolic agents increase gain 10-15 percent but are only effective for approximately 100 days. Limited information is available on the effects of reimplanting on cattle performance.

In another study the performance of cattle implanted with Ralgro was 17 percent better in suckling steers (1.99 lbs. versus 1.70 lbs. per head per day), 16 percent better in pastured steers (1.10 lbs. versus .95 lb. per head per day) and 14 percent better in feed lot steers (3.06 lbs. versus 2.68 lbs. per head per day). The effects of reimplanting were additive, and implanting three times resulted in 85 lbs. additional gain during the 288-day trial. A return of over $5 per $1 invested in Ralgro can be expected based on these results.

Three trials have been conducted on dairy steers fed the chemical elfazepam, which is reported to act as an appetite stimulant. When corn stover was a major portion of the diet, animals fed elfazepam did not eat more than controls. They did have more gain per pound of feed eaten. Research on dietary stimulants will be continued.

Nutrition-Related Diseases and Parasites

Worming calves prior to weaning and periodically thereafter is a commonly recommended practice, because the presence of internal parasites can usually be demonstrated by eggs in the feces. Fecal samples from calves in a Maryland feeder calf sale indicated that 68 percent of the calves and 90 percent of the farms consigning calves had parasite eggs.

The effects of worming on the performance of cattle were investigated with 51 purebred suckling steers and 42 feedlot steers. The effects of implanting steers three times with Ralgro from preweaning to market were also investigated.

Worming suckling beef steers resulted in gains similar to controls; however, the control cattle may have been on a better pasture. Worming feedlot cattle resulted in better gains during the first 59 days (2.55 lbs. versus 2.19 lbs.) but gains during the entire feedlot period (144 days) were only slightly better (2.96 lbs. versus 2.79 lbs.).

Animal Nutrition and Disease

PEM. The feeding of rations containing large amounts of grain to ruminants sometimes results in a noninfectious disease characterized by its sudden onset and improvement of symptoms by injecting thiamin (vitamin B_1). The disease is called polioencephalomolacia (PEM). Researchers suspect that PEM occurs when bacteria in the

Keeping cattle healthy is an important part of any cattle nutrition program. Experiment Station scientists have investigated the effects of worming on overall performance, and concluded that weight gains of wormed cattle are better than controls.

Mary McKenna examines a mouse for skin lesions and retarded growth, symptoms of a diet deficiency of essential fatty acids.

ruminant produce an enzyme which makes vitamin B_1 (thiamin) unavailable to the animal. Lambs in feeding trials using conventional high concentrate diets or purified diets with no thiamin showed no difference in either thiamin status or ruminal thiaminase production. Studies of the effects of varying pH on thiaminase activity in the laboratory indicate that acid conditions could predispose the rumen to the production of compounds which decrease thiamin availability. It appears that this disease is a problem only when high levels of grain and high acid conditions occur in the rumen.

Corn Silage and Stress. Corn silage is a preferred forage for most dairy herds because of economic production and handling and high nutrient yields per acre. In some feeding programs, corn silage as the only forage has resulted in the inability of cows to withstand the usual stresses of disease and infection. Displaced abomasums, increased mastitis, foot rot and other difficulties have been reported. Experiment Station studies involving 40 lactating cows over three successive lactations are now under way. Preliminary data indicate that when these rations are fully balanced for all nutrient requirements, there are no differences in response to stress between animals fed corn silage as the only forage for three lactations and animals fed corn silage during lactation and hay during the dry period.

Difficulties experienced with all corn silage rations may be the result of a nutrient imbalance or deficiencies in the ration rather than any specific difficulty with corn silage as a major feed component.

Fatty Acids Necessary for Normal Brain Development

Symptoms of a deficiency of essential fatty acids in the diets of young children and laboratory animals have long been recognized. Skin and kidney lesions and retarded growth are the usual symptoms.

The offspring of pregnant mice fed diets deficient in essential fatty acids exhibited marked retardation in brain growth. These data emphasize the necessity of fully balanced diets for pregnant women and infants if the children are to develop normally.

Efficient Poultry and Egg Production

Owen P. Thomas

The broiler industry, located mainly on the Eastern Shore, is the largest segment of a viable Maryland poultry industry, which represents a large portion of the total farm income. Egg production and distribution is the next largest segment and is located throughout the state with some concentration in the central Maryland-Baltimore area. The market for both meat and eggs has traditionally been the Northeast, centered around the Boston, New York and Philadelphia metropolitan areas. Because of expanded production of a healthy industry, market areas have been expanded to the south despite intense competition from other areas already established in the new market. Efficiency, high quality and sensitivity to consumer demands have created substantial expansion of both broiler and egg industries.

The Maryland Agricultural Experiment Station provides the research foundation to maintain an expanding poultry industry. The research philosophy is to anticipate problems and avoid crisis situations while maintaining the flexibility to apply concentrated research to unanticipated problems. The research, both basic and applied, can be divided into several areas: diseases, management, pollution, physiology, nutrition and products technology. Most research spans several of these traditional areas; scientists and engineers, cooperating to solve problems, do not maintain the traditional separation of expertise areas.

The research activity reported here will be divided along the traditional lines, but most projects involve at least one other area.

Respiratory Diseases of Poultry

The viruses isolated from many outbreaks of infectious laryngotracheitis on the Delmarva penin-

Ward Odenwald monitors the screen of an electron microscope to isolate infectious bronchitis viruses that attack Maryland poultry flocks. The isolation and cntrol of these viruses has saved the Delmarva poultry industry millions of dollars.

sula have been tested to determine whether any were different from the strain used for vaccination. No significant differences were found, indicating that the strain of virus used in vaccines is suitable.

A diagnostic procedure termed immune-electron-microscopy-agglutination has been developed for the characterization of the numerous strains of infectious bronchitis virus. This very precise analytical tool will be useful to test viruses responsible for this disease, which is a constant problem for the poultry industry. New tools of this kind are necessary if we are to continue to win the constant war against disease.

Management

Experiments are in progress to determine the effects of light and ventilation on chick performance. No difference in the performance of the birds was found when continuous lighting was compared with intermittent lighting after the birds were 10 days old, and intermittent lighting can save electrical energy. Air quality is important, and studies are in progress to measure concentrations of atmospheric ammonia. It has been found that low and medium ventilation rates, which result in higher ammonia concentrations, do not have an adverse effect on body weight at 56 days old. Broiler health was not affected except that higher ammonia concentrations increase the number of chicks found with eye infections.

Pollution-Physiology

A series of experiments was designed to determine which type of electrical stunner is best for maximizing bleed-out of broilers during the initial stages of processing. Three stunners were designed and tested: alternating current (AC) at 60 Hz, direct current (DC) and variable frequency. Experiments showed that settings for maximizing bleed-out for each stunner were, respectively: 50v (measured with a voltmeter); 90v (voltmeter); and 100v (peak voltage, measured with a cathode ray oscilloscope), 30v (voltmeter), 480 Hz.

When the three optimum settings were tested for best bleed-out, they were ranked in the following order: high frequency (480 Hz), AC and DC. The birds stunned with DC bled more slowly; therefore, it is recommended that in plants using DC stunners, the bleed-out time interval be increased from the standard 60 seconds to at least 90 seconds before having broilers enter a scalder. The total processing power consumption will be increased using any of the three electrical circuits. It was estimated that the AC circuit (60 Hz) is approximately 35 percent more efficient than the variable frequency stunning circuit and 225 percent more efficient than the DC circuit.

James Nicholson compares two young chicks to determine the effects of a change in rations on their growth. Nutritional studies are a major part of the Experiment Station research effort in poultry science.

Nutrition

The effect of chick age and vitamin D metabolites on the availability of phosphorus in defluorinated phosphate was studied by Experiment Station researchers in a series of experiments. Two age groups of growing broiler chicks (0-3 weeks and 4-7 weeks) were fed phosphorus from various

The instrument which Dr. Max Rubin is using can estimate the amount of xanthophyll in a sample of corn. This process allows scientists to determine the xanthophyll content in minutes instead of days.

commercial sources of defluorinated rock phosphate. Standard vitamin D_3 and two of its recently discovered metabolites, 25 OH D_3 and 1 α OH D_3, were also tested. Phosphorus from the above-mentioned sources was virtually 100 percent available to the 0-3 week old birds but only 82-92 percent available to the 4-7 week old birds. This probably reflects the decreased rate of skeletal development in the older birds. Although the metabolites proved to be 2-4.5 times as potent

as vitamin D_3, the use of these compounds in poultry feeds cannot be recommended because of cost considerations and current FDA regulations on feed additives.

Recently a series of studies was completed to evaluate the detoxifying effect of the essential trace mineral selenium on methyl mercury poisoning. These data showed that selenium addition to the diet actually increased the concentration of mercury in the liver of quail. Blood selenium levels also rose when both metals were in the diet. The very important enzyme glutathione peroxidase (GSH-Px), which is known to require selenium for activity in removing harmful peroxides from the body, was measured in the presence and absence of mercury. Inorganic mercury decreased blood GSH-Px activity; there was no change with organic mercury. Since methyl mercury increased blood selenium and there is no similar increase in blood GSH-Px activity, it appears that this selenium is not available for GSH-Px incorporation. Methyl mercury then is changing the metabolic role of some of the body's selenium.

Scientists at the Maryland Agricultural Experiment Station have found that by cleaning eggs in a solution of acetic acid they can save energy, time and water.

If high levels of rye (over 55 percent) are fed to chickens, they do not grow well and develop the characteristic sticky feces. Scientists have demonstrated that if antibiotics are added to a rye diet, the chicks will grow better. Recent Experiment Station work has shown that a similar growth depression and sticky feces can be obtained by adding pectin, which is found in rye, to a chick diet.

There is a big change in the type of microorganisms found in the intestines of chicks fed rye or pectin. When the diets are either high in rye or contain pectin, then the microorganisms produce gas. If antibiotics are added to the diet, the gas is reduced.

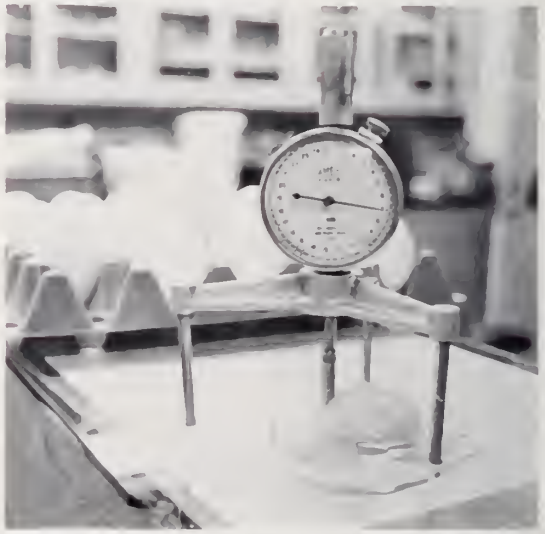
It would cost less to produce broilers in Maryland with a deep yellow pigmented skin if the yellow corn in their diets had a high level of xanthophyll. The savings could be in excess of $1 million per year. However, the cash corn crop farmer must be offered a premium as an incentive to grow the corn cultivars that are rich in xanthophyll. The rapid estimation of xanthophyll in corn will make this possible.

The basis for a new physical method has been established to develop a relatively low cost instrument for estimating xanthophyll in corn, in minutes, at the time it is delivered to the grain elevator. Chemical methods are too time consuming. The three different physical methods tested are: near infrared reflectance, visible light transmittance and visible light reflectance. Visible light transmittance gave the best result with sufficient accuracy to be used. This method was developed as a cooperative project between the Maryland Agricultural Experiment Station and the U.S. Department of Agriculture at Beltsville, Maryland.

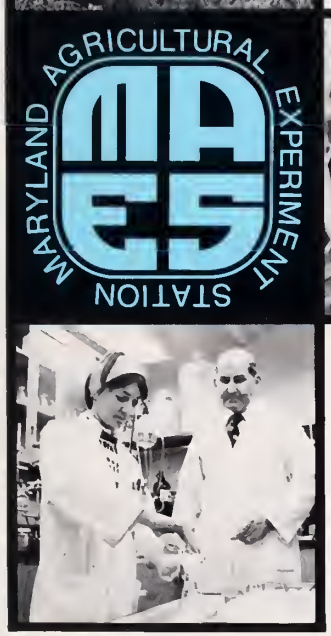
Products Technology

Broiler producers and processors continually search for more accurate means of estimating the meatiness of the carcass. Studies show that chilled carcass weight is the best indicator available. Attempts to mathematically estimate breast muscle volume as an indicator of breast weight are too time consuming to be practical and are no more accurate than body weight. The best bird is still the biggest bird.

Dilute acid immersion of shell eggs was found to be feasible as a method of cleaning. One disadvantage is a decrease in shell thickness, but the shell strength is no less than commercially washed eggs. Interior, organoleptic and functional quality could be maintained using currently accepted practices, and microbial quality of the shell is improved.



Following the washing cycle, acetic acid washed eggs are tested for height of albumen with a Haugh unit measurer.



Projects and Publications
1976-77

The Maryland Agricultural Experiment Station was established to develop, conduct and disseminate research information. The research projects, based on recommendations from farm organizations, the Cooperative Extension Service, or the scientists' knowledge of research needs, are funded by state funds, through the Maryland state legislature, and federal funds, through the Cooperative State Research Service. In addition, Experiment Station scientists collaborate with scientists and engineers of the U.S. Department of Agriculture.

This knowledge is communicated to the agricultural community through Experiment Station miscellaneous publications and bulletins. Miscellaneous publications reflect research findings with a relatively short reference value; bulletins deal with basic data which will be added to with time, and have a longer reference value.

Experiment Station scientists frequently submit scientific articles to various professional journals. These articles reflect the Maryland Agricultural Experiment Station's reputation for research excellence.

The following section lists projects, publications and scientific articles for 1976-77.

AGRICULTURAL AND EXTENSION EDUCATION

Projects

T-22 Recreational Carrying Capacity of State Forests in Maryland's Western Region. McIntire-Stennis — Rural Development. J. W. Longest, F. R. Kuss.

T-23 Community Structure and Quality of Life: Measurement and Analysis. Hatch — Rural Development. J. W. Longest, M. A. Konan.

T-24 Leadership and Personality in National Rural Youth Organizations. State. C. L. Nelson, J. Owings.

Miscellaneous Publications

901 Families' Use of Health Services in a Nonmetropolitan County: An Exploratory Study of Family Life Cycle, Income and Patterns of Use. M. A. Konan, J. W. Longest.

916 An Exploratory Study of the Relationship of Job Satisfaction to Work Values in the Maryland Cooperative Extension Service. G. C. Whaples, W. J. Milliken.

AGRICULTURAL AND RESOURCE ECONOMICS

Projects

A-18-AU Dairy Adjustments and Supply Response in Maryland and the Northeast. State. J. W. Wysong.

A-18-AX Organization of the World's Agricultural Resources. Hatch. P. W. Foster.

A-18-BB Maryland Farm and Open Country Real Estate Transfers. Hatch. S. Ishee.

A-18-BG Analysis of Costs and Returns to the Breeder-Owned Sectors of the Maryland Horse Industry. Hatch. R. G. Lawrence.

A-18-BJ Economic and Environmental Feasibility of New Pulp and Paper Mills in the Northeast. McIntire-Stennis. I. W. Hardie, G. E. Coene.

A-18-BK Evaluation of Incentives for Increasing Productivity on Non-Industrial Forest Tracts in Maryland. McIntire-Stennis. S. Ishee.

A-18-DA Optimum Economic Plans for Loblolly Pine Plantations in the Mid-Atlantic United States. McIntire-Stennis. I. W. Hardie, F. E. Bender.

A-18-DB Contrasting Energy Transformation in Grain Production. Hatch. P. W. Foster.

A-19-AC Comparative Impact of Current and Alternative Systems of Taxation on Farms and Counties. State. S. Ishee.

A-19-AE Economic Development Zone: A Strategy for Balanced Rural Growth and Development. Rural Development — Title V. A. Matteucci.

A-19-AG Economics of Solar Energy for Heating Maryland Broiler Houses. Hatch. J. L. Cain.

A-19-AI Public Outdoor Recreation as a Component for Rural Development in the Appalachian Region of Maryland. Hatch — Marketing and Rural Development. I. W. Hardie, I. Strand.

A-19-AJ An Economic Analysis of Agricultural Employment, Unemployment and Productive Changes in Maryland, the Northeast and the United States. Hatch — Rural Development. J. W. Wysong.

A-19-AK Optimum Farm Organization for Limited Resource Farmers. Hatch — Rural Development. D. F. Tuthill, R. Douglass.

A-19-AL Land Use, Taxes, and Service Impacts of Columbia, Maryland on Howard County. Hatch — Rural Development. W. J. Bellows.

A-26-CE Economic Analysis of the Maryland Horse Industry. Hatch — Marketing. R. G. Lawrence.

A-26-CI NE-86 Effects of Alternative Pricing Structures and Pooling Methods on the Dairy Industry in the Northeast. Hatch — Marketing. A. M. Prindle.

A-26-CJ NE-88 Future Economic Adjustments in the Marketing of Selected Northeast Fruits and Vegetables. Hatch — Marketing. J. L. Cain.

A-26-CK NE-91 Economic Evaluation of Alternative Management Strategies: The Atlantic Coast Clam Industries. Hatch — Marketing and Rural Development. I. Strand.

A-26-CL Economic Limitations to Feeding World's Growing Population. Hatch — Marketing. J. R. Moore.

A-26-CM Economics of Commercial Sod Production in Maryland. Hatch — Marketing. B. V. Lessley.

A-26-CN S-116 Supply, Pricing, and Marketing Alternatives for Cattle, Beef Systems in the South. Hatch — Marketing. J. E. Via.

A-26-CO NE-105 Implications of Demand, Structure and Energy Changes for the Northeast Broiler and Egg Industries. Hatch — Marketing. F. E. Bender.

Miscellaneous Publications

900 Iberian Antecedents of the Classical Hacienda of Latin America. P. W. Foster, A. Domen.

905 Industrial Contributions of the Economy of the Southern Delmarva Peninsula, 1972. H. M. Bahn, I. W. Hardie.

906 Optimal Management Plans for Loblolly Pine Plantations in the Mid-Atlantic Region. I. W. Hardie.

913 Maryland Dairy Farm Adjustment: Performances and Potential. J. W. Wysong, M. Seyala.

914 Economic Development Organizations in Nonmetropolitan Areas of Maryland: Planning Implications from Past Experiences. A. Matteucci.

Scientific Articles

A2262 Impact of Tractorization on Farm Labor Employment in India, A Case Study of Punjab. B. Nayak, J. W. Wysong. Abstract in the *Atlantic Economic Journal*, Vol. V, No. 1, Winter 1976.

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AGRICULTURAL ENGINEERING

Projects

R-21 Development and Construction of Specialized Facilities and Equipment for Use in Agricultural Research. State. K. E. Felton.

RG-40 Pilot Study of a Mechanized Composting System for Agricultural Wastes. Hatch. J. A. Merkel, J. H. Vandersall. In cooperation with Dairy Science.

R-43 Curing of Maryland Tobacco. Hatch. P. W. Winn, R. B. Brinsfield, A. T. Johnson.

R-45 Engineering Aspects of Closed Cycle Systems for Production of Fin and Shellfish. Hatch. F. W. Wheaton.

RM-2 Physiological Responses of Chickens to Varying Environments. Hatch. L. E. Carr, O. P. Thomas. In cooperation with Poultry Science.

RAM-49 Feasibility of Utilizing Solar Energy in Commercial Broiler Production. Hatch. J. L. Cain, K. E. Felton, O. P. Thomas. In cooperation with Poultry Science and Agricultural and Resource Economics.

R-50 Labor Performance While Wearing a Respirator. State. A. T. Johnson, L. Santa-Maria.

RAKO-51 Spray Irrigation of Domestic Waste Sewage Effluent to Forested Atlantic Coastal Plain Soils. Hatch. J. H. Axley, J. C. Stevenson, J. E. Ayars. In cooperation with Agronomy and Botany.

RD-52 Water Quality Changes on Oyster Processing. State. F. W. Wheaton, A. L. Ingling. In cooperation with Veterinary Science.

R-53 Shear Properties of Frozen Fish Fillet Blocks. Hatch —Marketing. F. W. Wheaton.

ROCG-54 Assessment of Non-Point Source Loadings from Selected Agricultural Activities. Hatch. J. E. Ayars, J. H. Axley, R. F. Davis. In cooperation with Agronomy, Animal Science and Dairy Science.

RO-55 Curing Primed Maryland Tobacco. Hatch. B. C. Frey, J. H. Hoyert.

Miscellaneous Publications

902 Maryland Natural Oyster Bars Location Index and Cross Reference to the Common and Official Names. J. Gird, F. W. Wheaton.

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A2259 Maryland Solar Energy Research as Related to Poultry — An Update. L. E. Carr, K. E. Felton, J. A. Merkel, J. L. Cain. Proceedings of Broiler House Seminar, October 1977, and Proceedings of Solar Energy National Symposium, November 1977.

A2270 Nitrification with Fish Culture Wastewater Pretreatment. K. M. Lomax, F. W. Wheaton. Transactions of the American Society of Agricultural Engineers.

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A2345 Digital Panel Meter to Display Stored Information. A. T. Johnson, A. D. Schlosser. *Electronics.*

AGRONOMY

Projects

B-43 Soybean Varietal Improvement. State. W. J. Kenworthy.

B-77 Forage Crop Variety Evaluation. State. N. A. Clark, J. H. McNemar

B-79 Use of Herbicides to Control Weeds in Forages. Hatch — Pesticide Project. J. V. Parochetti.

B-95 Control of Johnsongrass from Seed and Rhizomes. Hatch — Pesticide Project. G. W. Burt, J. V. Parochetti.

B-99 Factors Related to Irrigation of Tobacco. State. C. L. Mulchi, C. G. McKee, J. H. Hoyert.

B-101 Modified Cultural Practices and Environmental Control of Curing Tobacco. State. J. H. Hoyert.

B-103 Tobacco Breeding, Testing and Quality Evaluations of Maryland Tobacco. State. M. K. Aycock, J. H. Hoyert, C. L. Mulchi.

B-109 NE-57 Breeding and Evaluation of Kentucky Bluegrass and Associated Species for Turf. Hatch. C. A. Darrah.

B-111 Environmental Studies with Plants. Hatch. A. M. Decker, J. M. Walker.

B-116 Varietal Improvement in Wheat and Barley. Hatch. J. W. Johnson.

B-117 Biological Activity and Mode of Action of Herbicides Used on Corn, Soybeans and Tobacco. Hatch — Pesticide Project. J. V. Parochetti, G. W. Burt.

B-118 Agronomic Feasibility of Direct-Seeding of Field Tobacco. State. J. H. Hoyert.

B-119 Forage Production and Quality Evaluations. Hatch. A. M. Decker, D. J. Undersander, R. F. Dudley.

B-121 Principles of Dissipation and Movement of Triazine and Other Herbicides. Hatch. G. W. Burt, J. V. Parochetti.

B-122 Physiological Relationships of Tobacco to Environmental, Cultural and Genetic Factors. State. C. L. Mulchi, J. H. Hoyert, M. K. Aycock.

B-123 Response of Alfalfa to Fertility, Irrigation and Cutting Management. State. N. A. Clark.

B-125 Quality Turf Production. State. J. R. Hall, D. T. Hawes.

B-126 Control of Mexican Bean Beetle in Soybeans Through Resistant Varieties. Special grant agreement number 316-15-70. W. J. Kenworthy.

BO-1 Forest Buffer Strips in Controlling Animal Waste Runoff into Streams. McIntire-Stennis. D. C. Wolf, J. E. Foss, N. A. Clark.

BO-2 Effect of Municipal Sludge on Growth and Elemental Composition of Two Tree Species. McIntire-Stennis. J. E. Foss, D. C. Wolf, N. A. Clark.

BO-3 Evaluation of an Undisturbed Deciduous Ecosystem as a Source of Non-Point Pollution. McIntire-Stennis. D. C. Wolf, J. E. Ayars, J. F. Kundt. In cooperation with Agricultural Engineering and Horticulture.

BG-1 Beef and Dairy Replacement Production on Pasture. State. A. M. Decker, N. A. Clark, J. H. Vandersall. In cooperation with Dairy Science.

O-48 Soil Characterization Studies Relating to Their Genesis, Classification and Utilization. State. J. E. Foss, D. S. Fanning, J. R. Miller.

O-57 NE-39 Nitrates in Soils, Water and Plants. Hatch. J. H. Axley, J. Legg, F. Abbruscato.

O-81 Residual Effect of Thirteen Cropping Systems on Corn and Soybean Yields and Soil Aggregation. Hatch. E. Strickling.

O-82 Soil Testing for Environmental Control. Hatch. J. H. Axley, P. A. Snow, V. Pavanasasivam.

O-83 Nitrogen Fertilization of No-Tillage and Conventional Tillage Corn. State. V. A. Bandel.

O-84 Investigation of Heavy Metals in Sewage Sludge-Soil-Plant Systems. Hatch. D. S. Fanning, J. E. Foss.

O-85 Microbiology of Sewage Sludge Amended Soils. Hatch. D. C. Wolf.

O-86 NE-96 Soil Properties Affecting Sorption of Heavy Metals from Wastes. Hatch. D. S. Fanning.

O-87 Identifying and Preventing Sulfur Related Problems in Soils Created in Coal Mining Operations. PL 89-106 special grant agreement number 706-15-2. D. S. Fanning.

Miscellaneous Publications

903 Treatment and Feeding of High Moisture Baled Hay Using Organic Preservatives. C. C. Sheaffer, J. H. McNemar, N. A. Clark, J. H. Vandersall.

907 Effect of Time of Topping and Stage of Maturity at Harvest upon Performance of Maryland Tobacco. J. H. Hoyert.

909 Development of an Index of Quality for Maryland Tobacco. C. L. Mulchi.

910 Potomac — A New Soft Red Winter Wheat. J. M. Johnson, T. M. Starling, G. J. Shannon.

Scientific Articles

A2231 Pasture Renovation with Alternate Row Sod-Seeding of Different Legume Species. A. M. Decker, J. H. Vandersall, N. A. Clark. International Hill Land Symposium.

A2232 Minimum Tillage Establishment of Forage Species. A. M. Decker, R. F. Dudley. International Hill Land Symposium.

A2238 Determination of Total Sulfur in Tidal Marsh Soils by X-Ray Spectroscopy. R. G. Darmody, D. S. Fanning, W. J. Drummond, J. E. Foss. *Journal of the Soil Science Society of America.*

A2241 Modification of a Hay Baler for Applying Organic Preservatives to High Moisture Hay. J. H. McNemar, C. C. Sheaffer, N. A. Clark. *Agronomy Journal.*

A2248 Deicing Salt Movement and Its Effects on Soil Parameters. C. A. Buzio, G. W. Burt, J. E. Foss. *Agronomy Journal.*

A2263 Comparative Evaluation of *Rhizobium japonicum* Strains by Acetylene Reduction and Other Methods. N. Boonkert, D. F. Bezdicek, D. F. Weber. *Plant and Soil.*

A2268 Residual Herbicides on No-Tillage Corn in a Rye Cover Crop. J. V. Parochetti, A. W. Bell. 1977 Proceedings of the Northeastern Weed Science Society.

A2269 Herbicides for No-Tillage Double Cropped Soybeans. J. V. Parochetti. 1977 Proceedings of the Northeastern Weed Science Society.

A2271 Effects of Several Adjuvants on Preemergence and Postemergence Herbicides in 1976. J. V. Parochetti, H. P. Wilson, C. E. Beste. Proceedings of the Northeastern Weed Science Society.

A2293 Extractability of CD, CU, NI and ZN by Double Acid Versus DTPA and Plant Uptake at Excessive Soil Levels. R. F. Korcak, D. S. Fanning. *Journal of Environmental Quality.*

A2295 Canada Thistle Control in Timothy and Red Clover Sward. S. C. Peterson, J. V. Parochetti. *Weed Science.*

A2299 Metal Status of Plants and Soils in a Forest Tree Nursery Treated with Composted Sludge. R. F. Korcak, F. R. Gouin, D. S. Fanning. *Journal of Environmental Quality.*

A2306 The Mode of Pollination and Reproduction of *Limnanthes alba* Benth. M. B. Devine, J. W. Johnson. *Crop Science.*

A2316 Registration of Potomac Wheat. J. W. Johnson, T. M. Starling, G. J. Shannon. *Crop Science.*

A2328 Loess Deposits of the Eastern Shore of Maryland. J. E. Foss, D. S. Fanning, F. P. Miller, D. P. Wagner. *Soil Science Society of America Journal.*

A2343 Three Years Data on Warm and Cool Season Turfgrasses Grown in Combination Under Two Nitrogen and Two Topdressing Programs. D. T. Hawes. Third International Turfgrass Conference Proceedings.

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ANIMAL SCIENCE

Projects

C-25A Effects of Roughage Preparation. State. E. C. Leffel, S. C. Whelan.

C-34 Variability of Ovulation Rate in Swine. Hatch. E. P. Young, H. J. Brinkley.

C-35 Efficiency and Composition of Growth in Swine. Hatch. E. P. Young.

C-39 Analyses of Records of Beef Cattle Herds in Maryland. Hatch. W. W. Green.

C-43 Procurement and Study of the Gnotobiotic Ruminant. Hatch. E. C. Leffel, D. L. Kern.

C-44 Equine Serum Transaminases as Related to Muscular Work and Protein Nutrition. State. E. C. Leffel, D. L. Kern.

C-45 Measurements for Prediction of Weights of Cuts of Carcasses and for Evaluation of Beef Breeding Cattle. State. W. W. Green.

C-46 Carbohydrate Utilization. Hatch. J. DeBarthe, R. F. Miller.

C-48 Studies of Parasite Control in the Equine Gastrointestinal Tract. State. J. P. McCall, A. L. Ingling, C. McCullough.

C-49 Selection for Carcass Merit — Beef Cattle. Hatch. J. Buric.

C-51 Horse Hoof Characteristics, Their Control and Modification for Functional Durability. State. E. C. Leffel, E. E. Goodwin, J. E. Dinger.

C-52 Supplementation of Corn Stover for Wintering Gestating Beef Cows. Hatch. W. E. Kunkle, J. Buric, E. C. Leffel.

CD-54 Effect of Worming and Anabolic Agents on the Growth of Nursing Beef Calves. State. W. E. Kunkle, R. C. Hammond. In cooperation with Veterinary Science.

C-55 Effects of Iron Nutriture on Serum Proteins in Lead Poisoned Rats. State. J. V. Debarthe, C. Stone.

Technical Bulletins

A 187 Growth of Beef Cattle Within One Herd of Aberdeen Angus and Accuracy of Data. W. W. Green.

A 188 Heritabilities of Weights, Gains, Feed Efficiencies and Measurements in a Herd of Aberdeen Angus Cattle. W. W. Green.

Scientific Articles

A2229 Experience with Thiabendazole and Piperazine Phosphate: Failure to Demonstrate Resistance in Equine Intestinal Nematodes. J. P. McCall, C. McCullough. *Southwestern Veterinarian.*

A2230 Establishment of Ruminococcus Flavefaciens in Gnotobiotic Lambs. J. M. Weaver, E. C. Leffel. *Journal of Animal Science.*

A2314 Onchocerciasis Among Ungulate Animals in Maryland. C. McCullough, M. McCullough, G. I. Wilhelm. *Journal of Parasitology.*

BOTANY

Projects

F-12 Native Plants of Maryland. State. C. R. Broome, R. Brown.

F-21 Comparative Vegetative Anatomy of Flowering Plants. Hatch. W. L. Stern.

F-22 Plant Cell Wall Glycoproteins and Control of Cell Elongation. State. N. M. Barnett.

F-24 Biosystematic Studies of North American Vascular Plants. State. J. L. Reveal.

F-25 Cytogenetics of Pepper, *Lilium regale* and Corn. Hatch. D. T. Morgan.

J-93 Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. Hatch. O. D. Morgan, J. G. Kantzes.

J-98 Plant Viruses State. M. C. Corbett

J-101 Forest Tree Seedlings and Soil Fungi Relationships McIntire Stennis W. L. Klarman.

J-103 Production of Multiple Disease Resistant Type 32 Maryland Tobacco with Improved Quality and Yield Hatch O. D. Morgan, M. K. Corbett

J-105 Aflatoxins, Their Occurrence and Control Hatch G. A. Bean

J-106 NE-94 Role of Potato Stress Response Compounds in Adverse Biological Activity, Plant Disease and Insect Resistance Hatch M. C. Corbett

J-107 Selection and Nature of Induced Mutations in Higher Plant Cells. Hatch. P. J. Bottino.

J-108 Calcium Requirement for Infection of *Rhizobium japonicum* into Soybean Roots. PL 89-106 special grant agreement number 516-15-114 N. M. Barnett, D. G. Blevins, P. J. Bottino.

J-109 Mode of Action, Metabolism and Field Performance of Fungicides. Hatch. H. D. Sisler, J. G. Kantzes, N. N. Ragsdale.

J-110 NE-101 The Impact of Nematode Population on Crop Yield. Hatch. L. R. Krusberg.

K-13 Physiology of Chesapeake Bay Phytoplankton. State. E. P. Karlander.

K-14 Requirement for Potassium in Nitrogen Metabolism by Higher Plants. Hatch. D. G. Blevins, N. M. Barnett.

Scientific Articles

A2237 Fungitoxicity and Growth Regulation Involving Aspects of Lipid Biosynthesis. H. D. Sisler, N. N. Ragsdale. *Netherlands Journal of Plant Pathology.*

A2243 The Central American Species of *Centaurium* (Gentianaceae). C. R. Broome. *Brittonia* (New York Botanical Garden).

A2245 A Revision of *Eriogonum* (Polygonaceae), Subgenus Pterogonum. W. J. Hess, J. L. Reveal. *The Great Basin Naturalist.*

A2254 *Eriogonum* (Polygonaceae) of Arizona and New Mexico. J. L. Reveal. *Phytologia.*

A2258 The Association of Tomato Ringspot Virus with a Chlorotic Leaf Streak of Cymbidium Orchids. L. M. Goff, M. K. Corbett. *Phytopathology.*

A2265 Root Rot of Soybeans in Maryland. N. G. Klag, G. C. Papavizas, G. A. Bean, J. G. Kantzes. *Plant Disease Report.*

A2277 Sterols and Fatty Acids of Some Non-Photosynthetic Angiosperms. J. L. Stanley, G. W. Patterson. *Phytochemistry.*

A2279 Control of Pythium Blight on Bean with Ethazol and Prothiocarb. G. C. Papavizas, J. A. Lewis, R. D. Lumsden, P. B. Adams, W. A. Ayers, J. G. Kantzes. *Phytopathology.*

A2280 Effect of Tricyclazole on Growth and Secondary Metabolism in *Pyricularia oryzae.* M. C. Tokousbalides, H. D. Sisler. *Pesticide Biochemistry and Physiology.*

A2285 Low Levels of Solution Potassium Delays Pistillate Flower Production in Cucumis *sativus* L. D. Hildebrand, W. Frost, D. G. Blevins. *Plant Physiology.*

A2290 Comparative Anatomy and Systematics of Moutabeae (Polygalaceae). C. H. Styer. *Journal of the Arnold Arboretum.*

A2291 Lectin Content of Normal and a Non-Nodulating Mutant of Soybeans. A. C. Burgoon, D. G. Blevins, P. J. Bottino, N. M. Barnett. *Plant Science Letters.*

A2292 Uptake of the Nitrogen-Fixing Blue-Green Alga *Gloeocapsa* by Plant Protoplasts. A. C. Burgoon, P. J. Bottino. *Genetic Engineering for Nitrogen Fixation*, A. Holleander, Ed., 1977.

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A2308 The Effects of Calcium and the Ionophore A23187 on Nodulation, Nitrogen Fixation and Growth of Soybeans. D. G. Blevins, P. J. Bottino, N. M. Barnett. *Physiologia Plantarum.*

A2310 Effect of Tricyclazole on Melanin Production and Secondary Fungal Metabolism. H. D. Sisler, M. C. Tokousbalides. *Transactions of the Academy of Sciences of the German Democratic Republic.*

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A2321 Comparative Anatomy and Systematics of *Picrodendron*, Genus *Incertae sedis*. W. J. Hayden. *Journal of the Arnold Arboretum.*

A2327 Antifungal Mode of Action of Imazalil. M. R. Siegel, N. N. Ragsdale. *Pesticide Biochemistry and Physiology.*

A2332 The Ultrastructure of *Mychonastes ruminatus* gen. et sp. nov., a New Member of the Chlorophyceae Isolated from Brackish Water. P. D. Simpson, S. D. Van Valkenburg. *British Phycological Journal.*

A2333 Soil Algae from a Maryland Serpentine Formation. D. E. Terlizzi, Jr., E. P. Karlander. *Soil Biology and Biochemistry.*

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CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES

Projects

Z-1 Ecological Adaptation and Characteristics of 100 Geographic Populations of *Pinus strobus*. McIntire-Stennis. J. B. Genys, Inland Environmental Laboratory.

Z-2 Tree Damage and Forest Management Implications of the Locust Borer *Megacyllene robinia*, in Maryland. McIntire-Stennis. D. M. Harman, Appalachian Environmental Laboratory.

Scientific Articles

A2255 Results on Studies of Sixteen Geographic Strains of *Pinus strobus* and Four Other Species in Maryland. J. B. Genys. Proceedings of the Northeastern Tree Improvement Conference.

A2341 Intraspecific Variations in Himalayan White Pine, *Pinus griffithii*. J. B. Genys. Proceedings of the 13th Lake States Tree Improvement Conference.

COLLEGE OF HUMAN ECOLOGY

Projects

Y-7 NE-73 Nutrition Improvement in the Northeast Region. Hatch. L. C. Butler.

Y-10 NE-79 Consumer, Market and Laboratory Studies of Flame Resistant Textile Items. Hatch — Marketing. B.F. Smith, S. M. Spivak, R. Dardis.

Y-11 S-95 Quality Housing Environment for Low-Income Families. Hatch — Rural Development. G. S. Fish.

Y-12 An Analysis of Consumer Income and Expenditures. Hatch. E. A. Hacklander, R. Dardis, F. W. Derrick.

Miscellaneous Publications

908 Price Variations for Prescription Drugs. D. Dowdell, R. Dardis.

Scientific Articles

A2288 Price Variations for Prescription Drugs. R. Dardis, D. Dowdell. *Journal of Retailing.*

DAIRY SCIENCE

Projects

G-48 Flavor Quality of Concentrated Milk Products. Hatch — Marketing. M. Keeney.

G-52 Voluntary Intake, Availability of Utilization of Nutrients in Forages for Production. State. J. H. Vandersall.

G-56 Factors Affecting Energy and Protein Intake and Utilization in Ruminants. Hatch. R. F. Davis.

G-57 NE-72 Development of a Controlled Ovulation and Pregnancy Program in Cattle. Hatch. W. F. Williams.

G-58 Culture Studies on Sterile Milk. Hatch. D. C. Westhoff.

G-59 Evaluation and Shelf-Life of Sterilized and Pasteurized Milk. State. D. C. Westhoff.

G-62 Development and Application of Processing Technology for Dairy and Related Foods. State. J. F. Mattick, R. L. King, D. C. Westhoff.

G-63 Utilization of Dairy and Related Food Processing Waste Products. State. J. F. Mattick, R. L. King.

G-64 Mechanism of Glycosylation of Bovine K-Casein. Hatch. I. K. Vijay.

G-65 The Role of Membranes in the Secretion of Milk. Hatch. I. H. Mather.

G-66 NE-108 Optimizing Intake and Digestibility of Forages by Ruminants. Hatch. R. F. Davis, J. H. Vandersall.

G-67 Biochemical Studies on Milk Processed by Falling Film Sterilizer. Hatch — Marketing. I. K. Vijay.

G-68 Effects of Essential Fatty Acid Deficiency on Brain Development. Hatch — Marketing. M. Keeney, A. T. Campagnoni.

Miscellaneous Publications

903 Treatment and Feeding of High Moisture Baled Hay Using Organic Preservatives. C. C. Sheaffer, J. H. McNemar, N. A. Clark, J. H. Vandersall.

Scientific Articles

A2282 LH Response by Young Prepuberal Calves to Gonadotropin in Releasing Hormone. W. F. Williams, E. E. Zucker. *Journal of Animal Science.*

A2283 Urea Utilization by Lactating Cows. L. S. Bull, M. I. Poos, C. B. Tamplin. *Journal of Dairy Science.*

A2297 Role of Mannosyl Phosphoryl Polyisoprenol in Biosynthesis of Mammary Glycoproteins. I. K. Vijay, S. R. Fram. *Journal of Supramolecular Structure.*

A2309 Suitability of Paper Cartons for Long Term Storage of Milk. F. J. Feldstein, D. C. Westhoff, R. L. Kort, A. T. Johnson. *Journal of Food Process Engineering.*

A2352 The Heating of Milk for Microbial Destruction: A Historical Outline and Update. D. C. Westhoff. *Journal of Food Protection.*

DIRECTOR'S OFFICE

Miscellaneous Publications

912 Directory of University of Maryland Personnel Working in 208-Related Areas. C. S. Britt.

ENTOMOLOGY

Projects

H-67 NE-36 Pesticide Residues in or on Raw Agricultural Commodities. Hatch — Pesticide Project. R. E. Menzer.

H-74 Biology and Control of Tobacco Insects. State. F. P. Harrison.

H-100 NE-53 Degradation of Agricultural Pesticides in Biological Systems. Hatch. R. E. Menzer, J. O. Nelson.

H-103 The Circulatory System of Insects. State. J. C. Jones, M. Clark, M. Shauff.

H-104 Aquatic Insects in Maryland. State. W. E. Bickley.

H-105 Animal Metabolism of Plant Conjugates of Pesticides. State. R. E. Menzer, J. O. Nelson.

H-106 Management and Suppression of Destructive Insects on Soybeans and Alfalfa. Hatch. A. L. Steinhauer, L. M. Stevens.

H-107 Nantucket Pine Tip Moth — Parasite Relationships and Damage in Loblolly Pine Plantings. McIntire-Stennis. A. L. Steinhauer.

H-108 Studies on the Biology of Mosquitoes. State. J. C. Jones, T. M. Tadkowski.

H-109 Mutation Potential of Specific Baculoviruses Designated for Insect Control. Hatch. C. F. Reichelderfer.

H-110 Handbook of the Armored Scale Insects of Economic Importance in Maryland. State. J. A. Davidson.

H-111 Control of Orchard and Vineyard Pests. State. E. R. Krestensen.

H-112 Biology and Control of Vegetable Insects. Hatch. J. J. Linduska, F. P. Harrison, W. E. Bickley.

H-113 Biology, Ecology and Control of Insects Affecting Sweet Corn. Hatch. F. P. Harrison.

H-114 NE-102 Habitat Relationships and Roost Management of Flocking Blackbirds and Starlings. Hatch. D. H. Messersmith.

H-116 Honey Bee Pollination: Effects of Management and Pests on Honey Bee Populations. Hatch. D. M. Caron.

H-117 Insects on Turf and Economically Important Native Grasses in the State of Maryland: An Ecosystem Approach. Hatch. R. F. Denno.

H-118 The Biology and Control of Insect and Mite Pests of Ornamental Plants in Maryland. State. J. A. Davidson.

H-121 Agricultural Pesticide Impact Assessment. PL 89-106 special grant agreement number 701-15-90. A. L. Steinhauer.

Miscellaneous Publications

904 The Seasonal Distribution of Biting Flies in St. Mary's County, Maryland in 1975 (Diptera: Tabanidae, Muscidae). W. E. Bickley, R. S. Lawrence, J. Mallack.

Scientific Articles

A2234 Biosystematics of *Chionaspis nyssae* Comstock (Homoptera: Diaspididae), with Evidence Supporting Leaf and Bark Dimorphism of the Scale. R. C. Knipscher, D. R. Miller, J. A. Davidson. *Melanderia.*

A2235 A Taxonomic Study of Hemigymnaspis (Lindinger) (Homoptera: Diaspididae) Including Descriptions of Four New Species. J. A. Davidson, D. R. Miller. Proceedings of the Entomological Society of Washington.

A2251 *Macrocheles insignitus* Berlese (Acarina: Macrochelidae) Phoretic on *Nilobezzia schwarzi* (Coquillett) (Diptera: Ceratopogonidae). W. L. Grogan, Jr. Proceedings of the Entomological Society of Washington.

A2261 Diversity of Tabanid Fauna in Two Maryland Counties (Diptera: Tabanidae). W. E. Bickley. Proceedings of the Entomological Society of Washington.

A2281 Dog-to-Dog Transmission of Heartworm by *Aedes canadensis*. W. E. Bickley, R. S. Lawrence, G. M. Ward, R. B. Schillinger. *Mosquito News*.

A2286 Corn Earworm: Artificial Infestation as a Means of Evaluating Resistance in Sweet Corn. J. J. Linduska, F. P. Harrison. *Economic Entomology*.

A2289 The Nature and Distribution of European Corn Borer Feeding on Snap Beans. G. P. Dively II, J. E. McCully. *Journal of Economic Entomology*.

A2300 Bears and Beekeeping. D. M. Caron. *Bee World*.

A2302 The Fine Structure of the Imaginal Oenocytes of *Aedes aegypti* (Linnaeus). T. M. Tadkowski, J. C. Jones, J. Firman. *Annals of Entomological Society of America*.

A2313 Some Notes on the Ultrastructure of the Midgut in Starved and Blood-Fed Female Adults of the Mosquito *Aedes aegypti*. T. M. Tadkowski, J. C. Jones. *Cell and Tissue Research*.

A2317 Impact Studies of Nantucket Pine Tip Moth Populations on Loblolly Pine. J. H. Lashomb, A. L. Steinhauer, L. Douglass. *Environmental Entomology*.

A2323 The Optimum Population Strategy for Planthoppers (Homoptera: Delphacidae) in Stable Marsh Habitats. R. F. Denno. *Canadian Entomologist*.

A2329 Notes on the Biting Midges of the Seychelles (Diptera: Ceratopogonidae). W. W. Wirth, D. H. Messersmith. Proceedings of the Entomological Society of Washington.

A2330 Two New Species of Nearctic *Ochthebius* (Coleoptera: Hydraenidae). F. E. Wood, P. D. Perkins. *The Coleopterists Bulletin*.

A2351 Transformation of Human Lymphocytes by a Baculovirus Antigen. C. F. Reichelderfer. *Journal of Invertebrate Pathology*.

A2359 Can Homosexuality or Rape Occur in Non-Human Animals. J. C. Jones. *Science*.

HORTICULTURE

Projects

I-60 Perceptions of Scenic Resources in the Rural Landscape. State. D. G. Pitt.

I-74-A Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Plant Crops. State. J. B. Shanks.

I-74-B Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. State. J. B. Shanks.

I-74-C Cultural-Management Studies — Woody Plants. State. C. B. Link, F. R. Gouin.

I-74-N Control of Growth and Flowering of the Carnation. Hatch. J. B. Shanks, C. B. Link.

I-79-O Mineral Nutrients, Cultural Techniques and Winter Survival of Woody Ornamentals. Hatch. C. B. Link, F. R. Gouin.

L-73 Adaptation of Fruit Varieties and New Seedlings to Maryland. State. A. H. Thompson, H. D. Stiles.

L-74 Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. State. A. H. Thompson, B. L. Rogers, H. D. Stiles.

L-74-B Chemical Thinning of Peaches. Hatch. A. H. Thompson, B. L. Rogers.

L-74-D Investigations in High Density Plantings of Apple, Peach and Pear. State. A. H. Thompson. B. L. Rogers.

L-79-G NE-87 Control of Pests of Perishable Food Commodities in Marketing Channels. Hatch — Marketing. T. Solomos, J. A. Merkel.

L-79-J Use of CA Storage and Chemicals to Prolong Marketing Life of Apples, Potato Tubers and Cut Flowers. Hatch — Marketing. T. Solomos, R. C. Wiley.

L-101 Composted Sewage Sludge in Forest Nursery Seedling Production. McIntire-Stennis. C. B. Link, F. R. Gouin, J. F. Kundt.

L-103 Forest Tree Planting Trials. State. F. K. Schales, J. F. Kundt.

Q-58-K Development of Specifications for Canned Food Quality. State. A. Kramer.

Q-58-N Suitability of New Varieties of Horticultural Crops for Canning and Freezing. State. F. K. Schales, J. C. Bouwkamp.

Q-58-U NEM-30 Quality Maintenance, Measurement and Control in the Marketing of Vegetables, Including Potatoes. Hatch — Marketing. A. Kramer.

Q-58-V NEM-30 Quality Maintenance, Measurement and Control in the Marketing of Vegetables, Including Potatoes. Hatch — Marketing. J. C. Bouwkamp, T. Solomos.

Q-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. State. C. W. Reynolds, F. K. Schales.

Q-77 Crop Management Studies with Vegetable Crops. State. C. W. Reynolds, F. K. Schales.

Q-77-B Efficacy and Selectivity of Herbicides for Weed Control in Truck Crops. Hatch. C. E. Beste, F. K. Schales.

QR-77-C Interrelations of Cultural Procedures to the Mechanical Harvesting of Tomatoes. Hatch. J. C. Bouwkamp, J. W. Hummel, C. E. Beste, C. A. McClurg. In cooperation with Agricultural Engineering.

Q-77-E NE-92 Weed-Crop Competition — Tomatoes. Hatch. C. E. Beste.

Q-81 Cantaloupe Breeding and Selection. State. J. C. Bouwkamp, T. J. Ng.

QR-81-D Tomato Breeding and Selection With Particular Reference to Adaptation to Mechanical Harvesting and Processing. State. J. C. Bouwkamp, J. W. Hummel. In cooperation with Agricultural Engineering.

Q-81-E *Asparagus officinalis* Breeding and Genetic Studies. State. J. C. Bouwkamp.

Q-81-F Breeding of Horticultural Crop Plants. Hatch. J. C. Bouwkamp, C. B. Link, J. B. Shanks.

Q-81-G NE-66 Genetics and Physiology of Sweet Corn Quality and Biological Efficiency. Hatch — Marketing. R. C. Wiley.

Q-81-H NE-9 Discovery and Preservation of Valuable Plant Germ Plasm. Hatch. J. C. Bouwkamp.

Q-83 NE-48 The Dynamics and Energetics of the Soil-Plant-Atmosphere Continuum (SPAC). Hatch. C. W. Reynolds.

Q-84-E Balancing Costs Versus Sensory and Nutritional Gains in Refrigerated Storage of Foods. Hatch — Marketing. A. Kramer, F. E. Bender. In cooperation with Agricultural and Resource Economics.

Q-84-D Development of New Products and Improved Processing Methods. Hatch — Marketing. R. C. Wiley, A. Kramer.

QR-84-C Simultaneous Fruit and Vegetable Drink and Concentrate Production and Waste Water Purification by Directional Cooling. Hatch. A. Kramer, F. W. Wheaton, A. K. Olowofoyeku. In cooperation with Agricultural Engineering.

Miscellaneous Publications

917 The Redskin and Mar Series Peach Cultivars: Their Origin and Description. R. C. Funt, S. H. Todd, G. J. Stadelbacher.

Scientific Articles

A2233 Root Media and Fertilizers for Poinsettia — Part I: Prevention of Nutrient Disorders. J. B. Shanks. *The Maryland Florist.*

A2239 Soil Temperatures of Container Plants Overwintered Under Microfoam. F. R. Gouin. *American Nurseryman.*

A2240 Deciduous Tree Seedling Response to Nursery Soil Amended with Composted Sewage Sludge. F. R. Gouin, J. M. Walker. *Horticulturol Science.*

A2242 Freeze-Concentration of Aqueous Solutions by Rotational Uni-Directional Cooling. A. Kramer, D. Gil, A. K. Olowofoyeku. Proceedings First International Congress on Engineering and Food.

A2249 Root Media and Fertilizers for Poinsettias — Part II: Use of Municipal, Farm, and Forest By-Products. J. B. Shanks. *The Morylond Florist.*

A2252 Marked Growth Response of Woody Plants with Screened Composted Sewage Sludge. F. R. Gouin. Proceedings of the International Plant Propagator's Society.

A2256 Effect of Storage on Nutritive Value of Food. A. Kramer. *Journol of Food Quality.* Also published in *Hondbook of Nutrition ond Food,* CRC Press, Cleveland, Ohio.

A2266 Chemical Thinning of Spur-Type Delicious Apple Trees. B. L. Rogers, G. R. Williams. *The Maryland Fruit Grower.*

A2267 Evaluation of Activated Carbon and Linuron on Seeded Asparagus. C. E. Beste. Proceedings of the Northeastern Weed Science Society.

A2271 Effects of Several Adjuvants on Preemergence and Postemergence Herbicides in 1976. J. V. Parochetti, H. P. Wilson, C. E. Beste. Proceedings of the Northeastern Weed Science Society.

A2272 Uses of Endogenous Enzymes in Fruit and Vegetable Processing. R. C. Wiley. Book chapter in American Chemical Society Symposium Series: *Uses of Enzymes in Food Processing.*

A2273 Carotene Content of Sweet Potato Roots as Affected by Various Nematicide Treatments. J. C. Bouwkamp, J. G. Kantzes. *HortScience.*

A2275 Quality Control of Foods. A. Kramer. Staff Summary Report of Workshop on Agro-Industrial Development in the Dominican Republic October 1976.

A2276 Fate of Microorganisms During Frozen Storage of Custard Pies. A. Kramer, J. W. Farquhar. *Journal of Food Science*

A2284 Effects of Weather Conditions on Soluble Solids of Muskmelon (*cucumis melo* var. *reticulatus*). J. C. Bouwkamp, F. F. Angell, F. D. Scholes. *Scientia-Horticulturae.*

A2294 Conifer Tree Seedling Response to Nursery Soil Amended with Composted Sewage Sludge. F. R. Gouin. *HortScience*

A2301 Karyomorphology of Several Species of *Phaseolus* and *Vigna* L. S. Joseph, J. C. Bouwkamp. *Cytologia.*

A2304 Low Volume Sprays for Thinning Apples with Naphthaleneacetic Acid. B. L. Rogers, G. R. Williams. *Maryland Fruit Grower.*

A2311 Mechanized Seed-Fruit Identification. C. R. Gunn, L. R. LaSota. Proceedings Biosystematics in Agriculture (Beltsville Symposium II).

A2315 Using Sludge to Improve Soil. F. R. Gouin. *American Nurseryman.*

A2326 Cold Hardiness of Oriental Persimmons (Diospyros kaki) in Maryland. J. B. Shanks. *Annuol Report of Northern Nut Growers Association.*

A2331 Control of Growth and Flowering of Fuschia (*F. x Hybrida*) with Chemical Growth Retardants and Their Interaction with Photoperoid. J. B. Shanks, A. Purohit. Annual Proceedings of the Plant Growth Regulator Working Group.

A2335 The Potential Use of Antitranspirants in the Greenhouse Production of Chrysanthemums. J. D. Martin, C. B. Link. *Journol of Americon Society for Horticulturol Science.*

A2337 Growth Response of Broadleaf Evergreens to Soils Amended with Screened Composted Sewage Sludge. F. R. Gouin, C. B. Link. *Morylond Nurserymen's News.*

A2338 Cyanide-Resistant Respiration in Higher Plants. T. Solomos. *Annuol Review Plant Physiology.*

A2339 Influence of an Oxathiin (UBI-P293) on the Growth and Flowering of Azaleas. J. B. Shanks, A. Purohit. Annual Proceedings of the Plant Growth Regulator Working Group.

A2342 Overwintering Container Grown Plants Under Microfoam. F. R. Gouin. Proceedings of Woody Ornamentals Storage Symposium.

A2349 Container Nursery Stock Under Microfoam Survives Coldest Winter in 40 Years. F. R. Gouin. *Americon Nurseryman.*

A2353 Effect of Temperature Fluctuations on Energy Consumption and Quality Changes of Palletized Foods in Frozen Storage. W. Moleeratanond, A. Kramer, B. H. Ashby, W. A. Bailey, A. H. Bennett. Proceedings of IUFOST, August 1977.

A2354 Final Report, 18-Month Storage Study of Prepared Frozen Foods Containing Protein Concentrates. A. Kramer, R. L. King, D. C. Westhoff, A. D. Olowofoyeku, J. W. Farquhar. IIR Commission C-2 Symposium, September 1977.

A2355 Experience with T-T Indicators. A. Kramer, J. W. Farquhar. Proceedings, IIF-IIR, Commissions C-1, C-2, September 1977.

POULTRY SCIENCE

Projects

M-66 Applied Broiler Nutrition Studies. State. O. P. Thomas, J. L. Heath.

M-72 Day Length and Egg Production. State. C. S. Shaffner.

M-74 Recycling Broiler Litter Through Ruminants. State. W. E. Kunkle, L. E. Carr, O. P. Thomas. In cooperation with Animal Science and Agricultural Engineering.

M-108 Studies of Methods in Poultry Processing Plants and Hatcheries to Reduce Pollution. Hatch — Marketing. L. E. Carr, O. P. Thomas, W. J. Kuenzel.

M-109 Poultry Product Quality. Hatch — Marketing. J. L. Heath, C. J. Wabeck.

M-110 Morphological and Physiological Studies of an Epileptiform Seizure Pattern in Chickens, *Gallus domesticus*. Hatch. W. J. Kuenzel, M. M. Schaefer.

M-111 Cleaning and Preservation of Shell Eggs Without Refrigeration. Hatch — Marketing. J. L. Heath.

M-112 Metabolic Rates, Vital Signs, Body Temperature and the Control of Food Intake in Growing Chicks. Hatch. W. J. Kuenzel, J. H. Walther.

M-212
NE-73 Nutritional Improvement in the Northeast Region. Hatch. M. Rubin, O. P. Thomas.

M-213 Interrelationship of Selenium and Cystine with Mercury. Hatch. J. H. Soares, L. J. Kling, D. Rubenstein.

M-214 The Effects of Diet on the Toxicity of Lead in Quail, Mallard Ducks, and Chickens. State. J. H. Soares, R. B. Sleet.

M-215 Effects of Hydroxylated Vitamin D Metabolites on Egg Shell Quality. Hatch. J. H. Soares.

M-216 Amino Acid Requirements of Broilers and Laying Hens. Hatch. O. P. Thomas, E. H. Bossard, J. H. Soares.

Scientific Articles

A2236 A Rye Type Growth Depression of Chicks Fed Pectin. D. D. Wagner, O. P. Thomas. *Poultry Science.*

A2244 Basal Metabolic Rate in Growing Chicks, *Gallus domesticus*. W. J. Kuenzel, N. T. Kuenzel. *Poultry Science.*

A2246 Chemical and Related Osmotic Changes in Egg Albumen During Storage. J. L. Heath. *Poultry Science.*

A2247 Dietary Glycine Requirements for Growth and Cellular Development in Chicks. A. Ngo, C. N. Coon, G. R. Beecher. *Journal of Nutrition.*

A2253 Reproductivity of Japanese Quail Fed Mercuric Chloride in the Absence of Vitamin D. E. F. Hill, J. H. Soares. *Poultry Science.*

A2257 Effects of Chilling and Freezing Methods on Yield of Cooked Broilers. M. S. Goddard, J. L. Heath. *Journal of Food Science.*

A2296 Broiler Blood Losses with Manual and Mechanical Killers. C. E. Harris, T. A. Carter. *Poultry Science.*

A2298 Utilization of Analogues of Riboflavin by the Riboflavin-Deficient Chick Embryo. J. P. Lambooy, C. S. Shaffner. *Journal of Nutrition.*

A2305 A Comparison of Plate and Brine Stunners, A. C. and D. C. Circuits for Maximizing Bleed-Out in Processed Poultry. W. J. Kuenzel, A. L. Ingling. *Poultry Science.*

A2320 An Adaptive Growth Response of Chicks Fed Rye. D. D. Wagner, O. P. Thomas, G. Graber. *Poultry Science.*

A2322 Electrical Terminology Measurements and Units Associated with the Stunning Technique in Poultry Processing Plants. A. L. Ingling, W. J. Kuenzel. *Poultry Science.*

A2324 The Effect of Egg Size on the Relative Percentages of Thick, Inner Thin and Outer Thin Albumen. J. L. Heath. *Poultry Science.*

A2325 Dilute Acid Immersion as a Method of Cleaning Shell Eggs. J. L. Heath, D. J. Wallace. *Poultry Science.*

A2336 Effect of Diet and Type of Birds on the Carcass Composition of Broilers at 28, 49, and 59 Days of Age. P. V. Twining, O. P. Thomas, E. H. Bossard. *Poultry Science.*

A2346 Genetic Influence on Breast Blisters of Broilers. C. S. Shaffner, J. L. Nicholson. *Poultry Science.*

A2347 Variable Frequency and a Comparison of Two Bleed-Out. W. J. Kuenzel, A. L. Ingling, D. M. Denbow, J. H. Walther, M. M. Schaefer. *Poultry Science.*

A2356 Converting Male Broilers to Periodic Feeders: Effects of Food Intake, Growth, and Body Composition. B. E. Conard, W. J. Kuenzel. *Poultry Science.*

A2357 The Effect of Diet on Liver Glycogen and Body Composition in the Chick. K. W. Seaton, O. P. Thomas, R. M. Gous, E. H. Bossard. *Poultry Science.*

VETERINARY SCIENCE

Projects

D-63 Virology of the Bovine Respiratory Complex. Hatch. S. B. Mohanty.

D-70 Virology of Equine Respiratory Disease Complex. Hatch. S. K. Dutta.

D-71 Adequacy of Thermoregulatory Response to Cold Stress as a Factor in Decreased Disease Resistance. State. T. F. Albert, A. L. Ingling.

D-73 Veterinary Support for University of Maryland Animals. State. D. L. Campbell, J. P. Davidson, R. C. Hammond.

D-74
NE-109 Detection and Control of Three Economically Important Avian Diseases. Hatch. W. W. Marquardt, R. B. Johnson.

D-75 Infectious Laryngotracheitis (ILT), Avian Influenza (AI) and Infectious Bursal Disease. State. W. W. Marquardt, R. B. Johnson.

Scientific Articles

A2250 In Vivo Persistence in Equine Tissue Macrophages of Herpesvirus Type 2 Detected in Monolayer Cell Culture. S. K. Dutta, D. L. Campbell. *Infection and Immunity.*

A2303 Lymphocyte Responsiveness to Mitogens and Quantitation of T and B Lymphocytes in Canine Leukemia. S. K. Dutta, M. N. Novilla, A. L. Ingling. *American Journal of Veterinary Research.*

A2318 Metastasizing Basal Cell Carcinoma and Renal Cortical Adenoma in a Woodchuck, *Marmota monax*. T. F. Albert, J. P. Davidson, A. L. Ingling. *Journal of the American Veterinary Medical Association.*

Financial Statement 1976-77

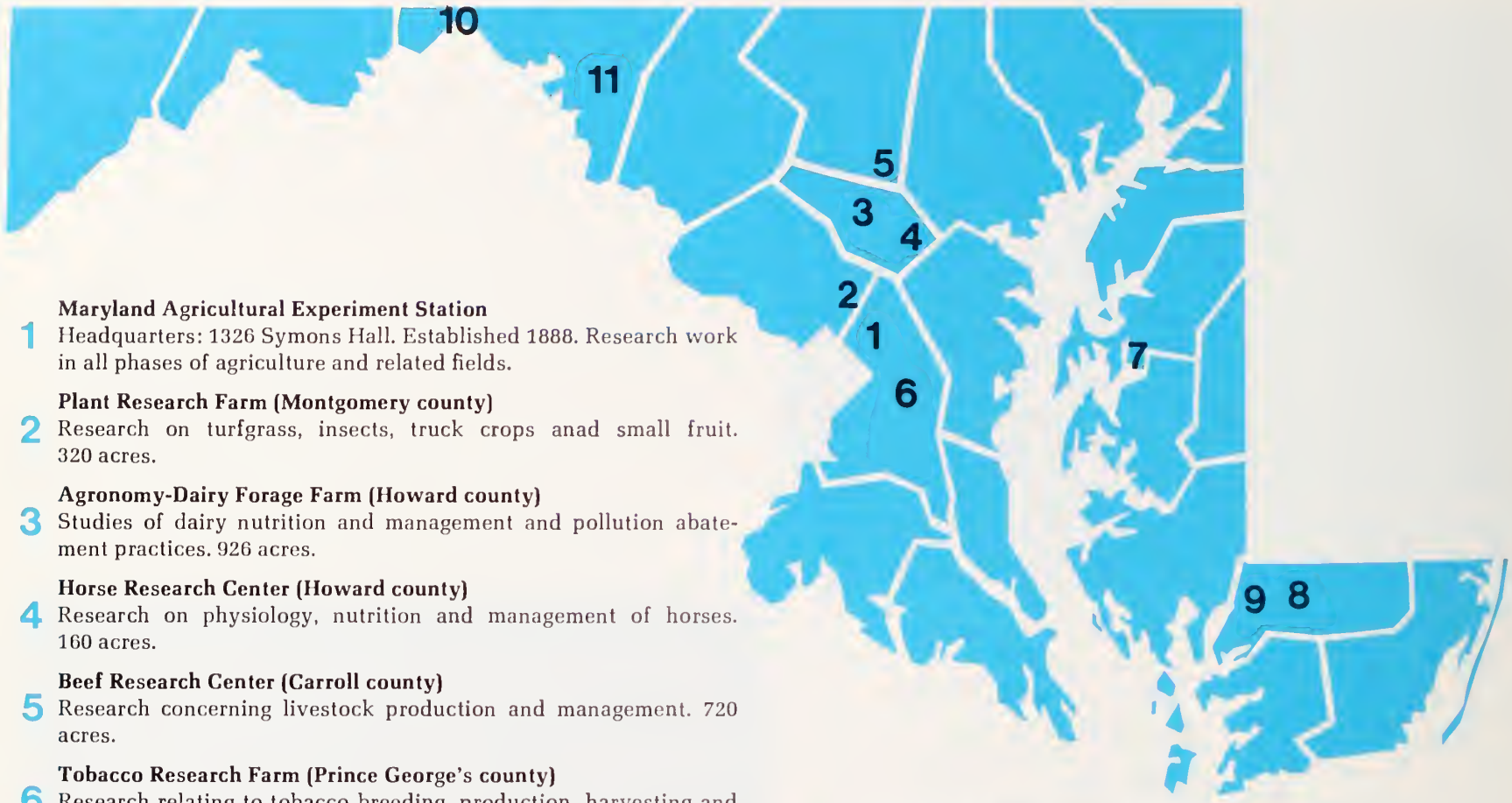
SOURCES OF INCOME

Hatch Formula Funds		
Transition Quarter Funds	$218,306	
¾ of Federal FY 77 Funds (1,003,098)	752,324	$ 970,630
Hatch Regional Funds		
Transition Quarter Funds	79,061	
¾ of Federal FY 77 Funds (350,584)	262,938	341,999
McIntire-Stennis Funds		
Transition Quarter Funds	23,480	
¾ of Federal FY 77 Funds (113,660)	85,245	108,725
Rural Development Funds		
Transition Quarter Funds	4,431	
¾ of Federal FY 77 Funds (17,723)	13,292	17,723
Total Federal Funds		1,439,077
State Appropriation Per State FY 77 Budget		3,213,337
Total Funds		**$4,652,414**

EXPENDITURES BY MAJOR RESEARCH AREAS

	Percentage	Amount
Natural Resources and Environmental Quality	7	$ 325,669
Forestry Production	5	232,621
Field and Horticultural Crops	35	1,628,345
Animals and Poultry	39	1,814,441
People, Communities and Institutions: Nutrition, Food Safety, Clothing and Housing	7	325,669
Marketing, Trade, Price and Income Policy	5	232,621
General Resource Technology	2	93,048
Total	**100**	**$4,652,414**

Maryland's Research Farms



Maryland Agricultural Experiment Station
1 Headquarters: 1326 Symons Hall. Established 1888. Research work in all phases of agriculture and related fields.

Plant Research Farm (Montgomery county)
2 Research on turfgrass, insects, truck crops anad small fruit. 320 acres.

Agronomy-Dairy Forage Farm (Howard county)
3 Studies of dairy nutrition and management and pollution abatement practices. 926 acres.

Horse Research Center (Howard county)
4 Research on physiology, nutrition and management of horses. 160 acres.

Beef Research Center (Carroll county)
5 Research concerning livestock production and management. 720 acres.

Tobacco Research Farm (Prince George's county)
6 Research relating to tobacco breeding, production, harvesting and curing. 206 acres.

Wye Institute (Queen Anne's county)
7 Work on plant breeding, weed and disease control, and production systems for corn, soybeans, vegetables and ornamentals. 125 acres.

Salisbury Research Substation (Wicomico county)
8 Experimental studies dealing with poultry and breeding, insect, pest and disease control, production systems and management and processing of vegetable crops. 881 acres.

Poplar Hill Research Farm (Wicomico county)
9 Studies of disease control, breeding, pest control and production systems for corn, soybeans and vegetable crops. 100 acres.

Fruit Research Center (Washington county)
10 Research on fruit production, disease control and fruit insects. 28 acres (leased).

Sharpsburg Research and Education Center (Washington county)
11 Research on fruits, vegetables, ornamentals, field crops, soils and disease and insect control. 546 acres.